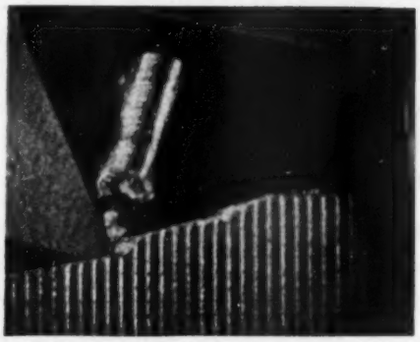
AMERICAN MACHINIST

July 23, 1941



Screen Test—*High-speed photography shows precisely what happens when a tool forms a chip in cutting a piece of metal*

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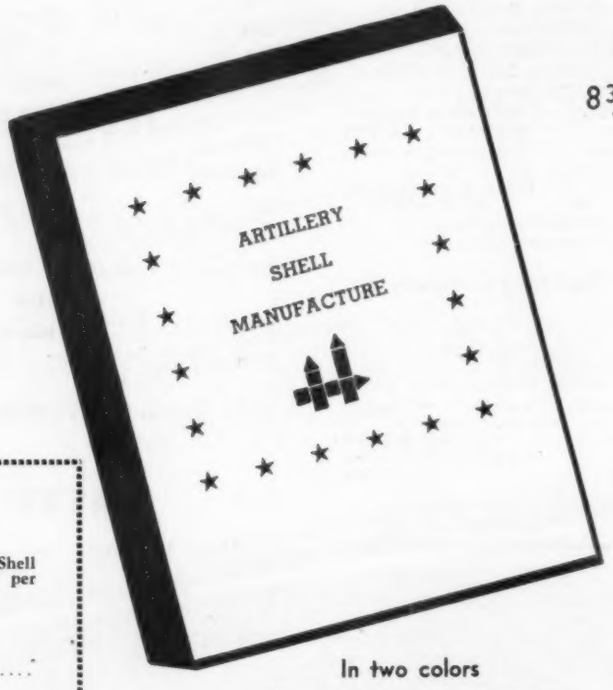

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WHAT'S IN THIS ISSUE

GUNS AND MASS PRODUCTION

When General Motors contracted to make the Browning machine gun on a mass production basis for the U. S., they began systematically to unearth all that was known about the job. They went to arsenals, gun plants like Colt, and machine-tool builders. As a result of this investigation new tools were developed for gun barrel drilling, reaming, broaching the rifling, and chambering. Tooling up was emphasized, old methods modified. This story—"From Motor Cars to Machine Guns"—is told in the 20-page Armament Section beginning on page 703.

L. T. WELLER

HIGH SPEED PHOTOS

For a long while many questions regarding chip formation in the cutting of metal in various machine tools have gone unanswered because "yer jus' couldn't see 'em." However, General Electric engineers have since developed a high-speed photography. Now the fastest operation can be seen through the slow motion camera. In a recent trial L. T. Weller, works laboratory, Schenectady, had charge of the set-ups and E. M. Watson, lamp department, Cleveland, took the pictures. Both men have collaborated in writing "Tools Seen in Slow Motion" which begins on page 689. Because almost all your questions can now be answered, you won't want to miss this material.

MORE ABOUT TRAINING

When a town has many jobs to offer and yet many of its residents are jobless, something's wrong. Such a town was Williamsport, Pa., in 1930. Dr.

E. M. WATSON

George H. Parkes knew that jobless men walked the streets because they didn't have the mechanical skill necessary to hold down the jobs available. He changed all that by establishing the Adult Training School and since has turned out thousands of skilled men who have taken their place in industry. Today the school's a life saver. It's a Mecca for many who seek expert advice, instruction, and a job in a defense industry. The story is told in "Adult Training Grows Up" on page 696.

STEEL SELECTION

In flame hardening one of the prime considerations is the proper selection of materials. J. G. Magrath, applied engineering division, Air Reduction Company, continues his series of articles on Oxyacetylene Flame Hardening with the third installment, "What Steels to Use." Because this material has proven so valuable you will want to have the complete information. Turn to page 698.

REAMER STANDARDS

Although most metal-working people know all the ins and outs about reamers and other tools, some do not always know about the adoption of new standards until they have lost time and money because of it. Last June the American Standards Association approved new standards for reamers which were sponsored jointly by the Society of Automotive Engineers, the National Machine Tool Builders' Association, and the American Society of Mechanical Engineers. This important data, which begins on page 723, is money in your bank.

MACHINING SPINDLES

Not long ago Jones & Lamson Machine Company developed an improved manufacturing procedure for machining spindles for Fay automatic lathes, turret lathes, and thread grinders. From the rough forging to the completed job 23 operations are used and each is set up to take full advantage of modern cutting tools and methods. Leigh A. Banister and John Lawrence, of Jones & Lamson, describe the operations in all their important details in "Precision in Spindles." This interesting and practical data begins on page 693. You'll find it instructive, too.

JOHN LAWRENCE (left) and LEIGH BANISTER

COMING

Taper sectioning has been found tremendously useful as a means of studying the surface contour of metals. In an early issue of AMERICAN MACHINIST, H. R. Nelson of the Battelle Memorial Institute will describe this technique which was developed as part of an investigation of surface finishes sponsored by the Norton Company. Beginning in the next issue is a short series of articles which cover all major considerations in the selection of "Work Clamp Devices." They'll be written by John G. Jergens, Cleveland Pneumatic Tool Company.

In the Armament Section of the August 6 issue the story of building a bomber at the Glenn L. Martin plant will be unfolded. The most important production details of the medium bomber (the B-26) will be described in an article extensively illustrated. It deserves every laudatory adjective.

Cincinnati
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TURRET LATHES

26% TIME SAVED FOR CINCINNATI PLANER!

The two CINCINNATI ACME Universal Turret Lathes shown above are in the plant of the Cincinnati Planer Co. The one in the foreground is rough turning bevel gears, and doing the job, according to Cincinnati Planer's records, at an average time saving of 26%. The machine is a No. 3S CINCINNATI ACME Universal Turret Lathe having a 4½" bar capacity with a 26½" swing over vees, 24½" over carriage wings and 18½" over bridge of cross-slide.

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...The ACME MACHINE TOOL CO.,
...CINCINNATI. OHIO.

ESTABLISHED 1877 **AMERICAN MACHINIST** BURNHAM FINNEY, Editor

Tools Seen in Slow Motion

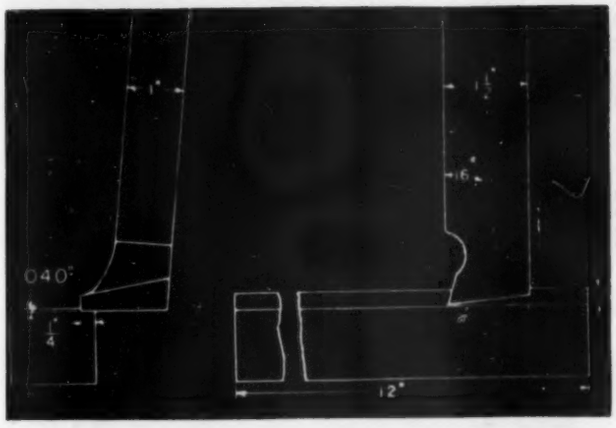
BY L. T. WELLER, WORKS LABORATORY, GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.
AND E. M. WATSON, LAMP DEPARTMENT, GENERAL ELECTRIC COMPANY, CLEVELAND, OHIO

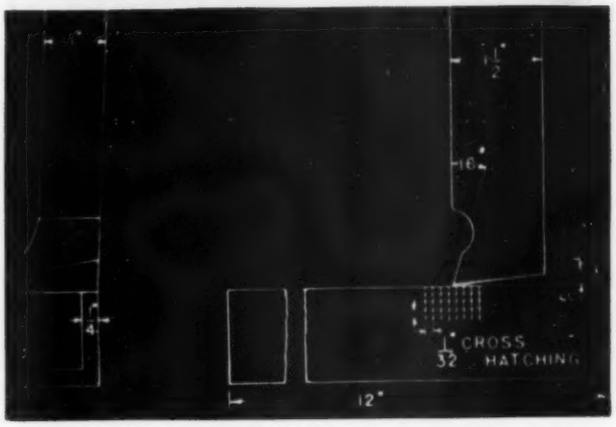
G. E. engineers find high-speed photography useful in answering questions on chip formation when cutting metals on different machine tools

RECENTLY, the Engineering General Department and Works Laboratory of the General Electric Company, using high-speed photography, began the study of what takes place when metal is cut on machine tools. In this work, done under the direction of W. L. Merrill and H. J. Vanderstadt, it was first decided to determine the extent to which photographic technique could be used to reveal what takes place when the metal gives way at the cutting face of the tool. The first experiments were made using a planer and a milling machine for cutting steel, cast iron and brass. The set-ups were in charge of L. T. Weller, and the pictures were taken by E. M. Watson.

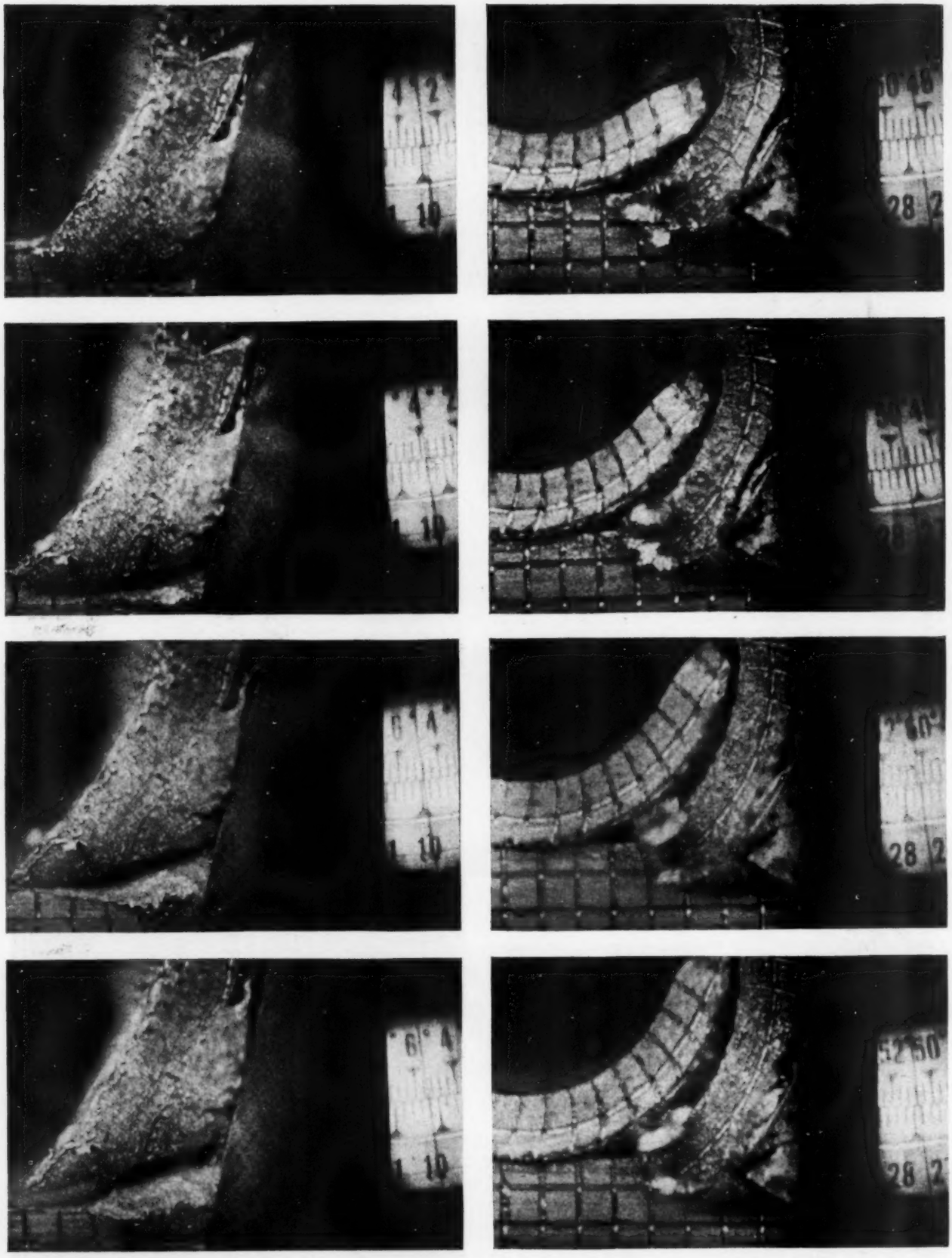
In making these pictures, care was taken to have the speeds, feeds and tool shapes appropriate for the kind of work being done. In the work on the planer, a cut was first made in an interior corner on SAE 1020 steel as an experimental view to see what would be needed for subsequent views. It was found that one edge of the chip was torn away from the workpiece, making it curl unsymmetrically, and extend in front of the tool, obscuring the view for part of the cut. This was remedied by substituting a narrow workpiece for the wide block, permitting all of the separation of the chip from the block to take place at one surface. While in the first picture the point of the tool was in the interior corner, the use of the narrow block permitted the tools to be moved away from the camera until the side of the tool and the side of the block viewed by the camera were in the same plane. With this arrangement, the cut was uniform throughout the chip, and the action observed in the plane of the side of the block was about the same as was taking place throughout the entire thickness of the block.

The front of the block was ground, and both vertical and horizontal lines were inscribed on it $\frac{1}{32}$ in. apart. The purpose of these lines was to show approximately the amount of chip taken off and to permit identification of the metal in the chip with regard to previous location in the block. For example, when machining steel with a tool having a blunt





Camera and lights (above) are set-up for high-speed photographs. The first tool (center) cut to a shoulder and curled the chip so that the cutting action was obscured. A revised set-up gave uniform chip thickness and kept tool and work in the same plane



An enlarged $\frac{1}{4}$x$\frac{1}{4}$-in. section shows a tool with a 16-deg. top rake taking a cut in mild steel. Note the parting of the metal ahead of the tool and its distortion as indicated by the scribed lines

Changing the rake angle to 24 deg., still using mild steel on a planer, gives less distortion of the metal ahead of the tool and a smoother chip flow. The upper section is the chip curled back inside itself

rake angle, the chip is crushed, and the areas bounded by the lines on the chip are in the shape of oblongs while they were square on the block. With a greater rake angle the chip is rolled up without so much crushing action, and the areas remain approximately as square on the chip.

In the case of cast iron, the pieces are generally broken off without distortion because of the nature of the material. With a heavy cut, there are many pieces of about the same dimension in all directions equal to the depth of the cut. The breaking away of these pieces ahead of the tool produces a rough surface directly in front of it. As the tool passes over this surface, many smaller pieces are removed. There are also similar small pieces broken off by the abrasive action, as the large pieces are removed.

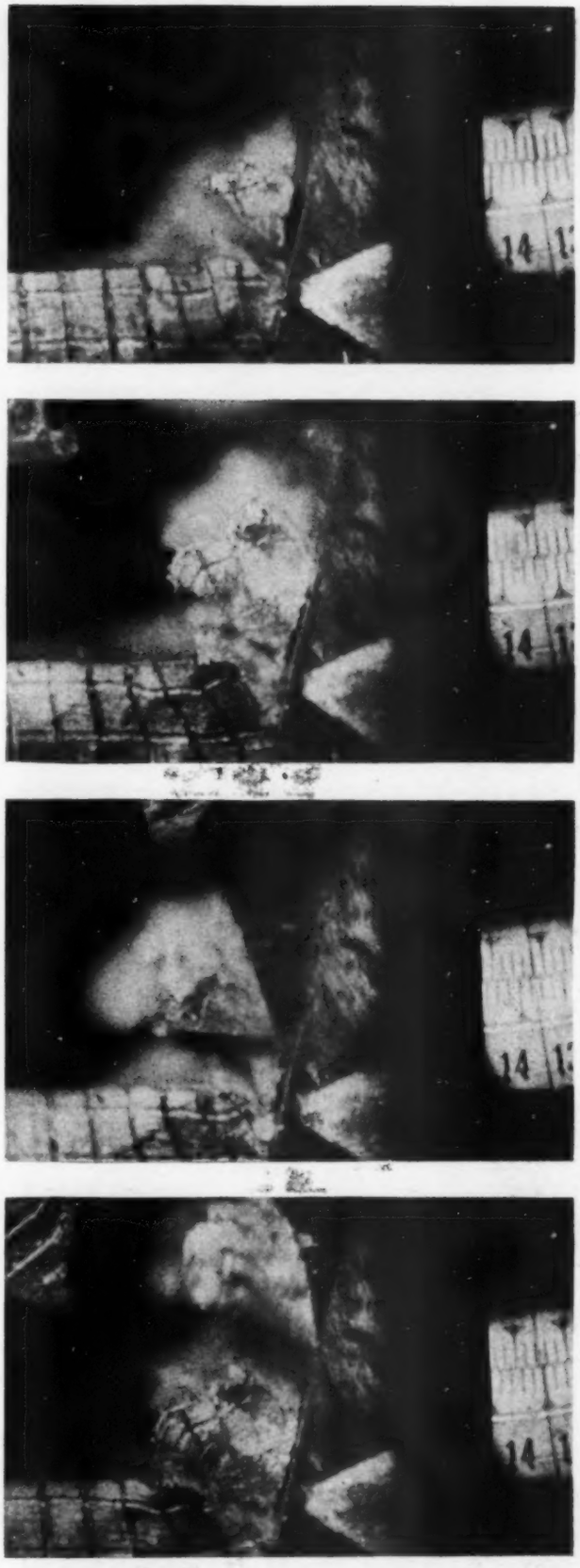
Brass is peculiar in that the chips are compressed at the bottom into shapes resembling wedges. As these move out, the pressure on the tool is relieved somewhat, causing it to spring forward and thus to move the chips out at a faster speed than would be the case if the deflection of the tool was negligible. This may account for the fact that, when turning brass at a fairly high cutting speed, the operator may feel many chips striking him with considerable velocity, while this is not so noticeable for other metals.

Break-Out at End of Cut

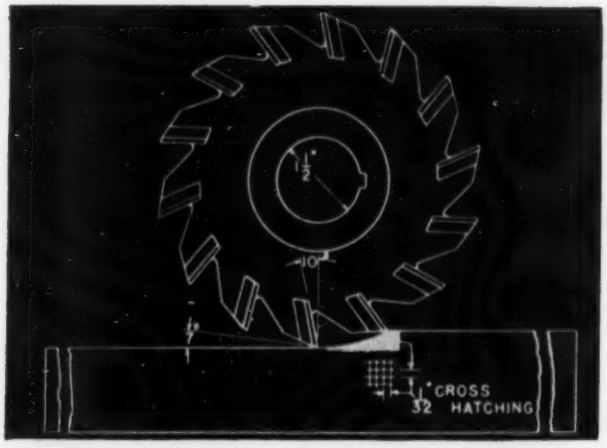
When starting a cut with these various materials, one can see how the tool is deflected in the direction of travel of the metal, when it makes contact, until enough pressure has been built up to start the cut. When the end of the cut is approached, there is decreasingly less metal ahead of the tool, resulting in a section at the end of the block which gives way in a manner somewhat different from that in which the metal removed earlier was taken off. The material removed at the end often extends somewhat below the surface of that which is removed some distance from the end. This occurs because of the changes in forces acting within the block. When the cut is some distance from the end of the block, there is plenty of metal ahead of the tool to take the compression. As the end of the cut is approached, metal to take this compression exists only up to the end of the block. At the very end of the chip, forces involving shear and tension figure with more importance, causing the chip at this point to differ somewhat from what it is at some distance from the ends.

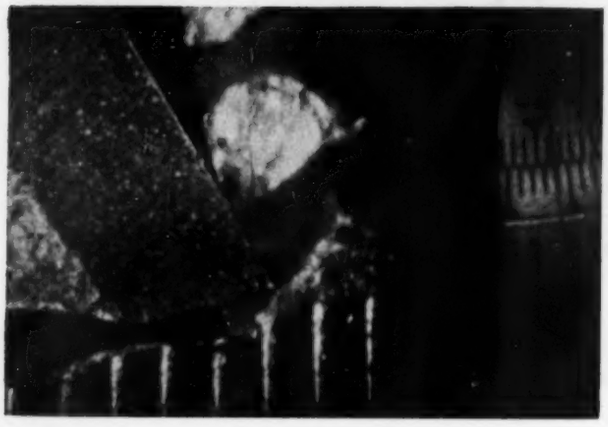
All of the views of the planer were taken with a single, small area to show the chip action at the point of the tool. Two sizes of views were used for the milling machine pictures. The large area showed the teeth of the milling cutter during the entire time it was in contact with and cutting the metal. The small area showed the chip formation at the time the cutter left the work, the point at which there is the greatest depth of cut. When a cut is made with the machine heavily loaded, as was the case here, each cutter tooth puts increasing strain on the shaft as it progresses, because of the increasing thickness of the cut. This causes the shaft to wind up somewhat. As the tooth emerges from the cut, this energy in the shaft is released, causing the cutter to spring forward an amount usually depending on the extent of contact of the subsequent tooth with the work. When the subsequent tooth is stopped by contact with the work, there is a short pause until enough pressure at the tooth is built up to cause it to continue on its way. For the heavier cuts, this action becomes more pronounced and was observed as chatter.

An Eastman type II high-speed camera was used for taking these pictures. In order to take pictures which permit approaching the ultimate in performance by this method of photography, proper accessories are necessary. It might be said that the results in general depend on the product of the following three factors: camera, accessories and ability



A close-up view of the planer tool working on cast iron shows the greater fragmentation of this metal. The pointer indicates tool deflection. In all these pictures the action was slowed to 1/60 of normal speed





of the operator to use them. Even though the condition of any two is all that is desired, inadequate conditions in the third will impair the results. Since the field of high-speed photography is not broad, the user can purchase the camera but not the accessories to any extent. A few devices which can be purchased are adaptable, but for the most part it is necessary for the user to employ his ingenuity in the design and construction of the accessories necessary to obtain many of the different views which would otherwise be impossible. There are only a few people anywhere who are giving thought to constructing and using accessories; therefore, each person in the field is almost entirely on his own. Although practices used in normal speed or still photography can be used for high speed, in most cases conditions are so different, because of the speed, that many refinements have to be made.

Results Best When Shop Is Idle

In taking these pictures, it was found best to work during the week-end or at night in order to avoid vibration from neighboring equipment. Because of the small area involved, any slight motion between the camera and the machine would register as a considerable variation in the picture. In order to make certain that the view taken during each shot was properly registered, negative film was used, allowing immediate development and examination before each set-up was taken down. Because of this procedure, the shot of the internal corner, previously referred to, was not found to be as satisfactory as desired; therefore, the set-up was changed to show the side of the tool cutting on a narrow bar. The cross-hatching on the side of the bar, to permit identifying the previous location of the metal in the chip, was added at this stage. In general, the major changes were made after the first shot, the examinations of subsequent shots being made essentially to check progress.

High-speed photography can be used, we believe, to study the action of chip flow as influenced by various rake and clearances angles on single-point cutting tools, such as lathe and planer tools, and also on milling cutters.

The effect of coolant on chip flow can be studied to determine just how the coolant allows the chip to pass over the tool face without the welding action that is present in dry cutting.

Also, the process shows the effect of the chip being torn away from the material being cut and what happens to the structure of the material ahead of the tool.

By the use of the high-speed film, workmen, students, engineers and other interested in the efficiency of metal cutting are able to see more definitely what takes place at the cutting edge of the tool while operating at normal cutting speeds. This cannot be determined by any other means because the actual cutting on a machine is too rapid for the eye to see. The high-speed camera catches every detail, magnifies it and then the action is slowed up when thrown on the screen so that detailed study can be made more readily.

The views which are presented here are taken from the two-reel, 16-mm. silent motion picture called "Making Chips." This has been shown at a number of meetings where performance of this kind is of interest and can be borrowed for future showings from the Visual Instruction Section of the Publicity Department, General Electric Company, Schenectady, New York.

An 18-4-1 high-speed steel milling cutter on brass plainly shows how the chips are thrown clear of the cut. The top view gives the dimensions of the milling cutter which had a ½-in. face. The feed was 30 in. per inch

Precision in Spindles

BY LEIGH A. BANISTER AND JOHN LAWRENCE, JONES & LAMSON MACHINE COMPANY

Twenty-three operations now used to complete the spindle for a Fay automatic lathe are set up to take full advantage of modern tools and methods

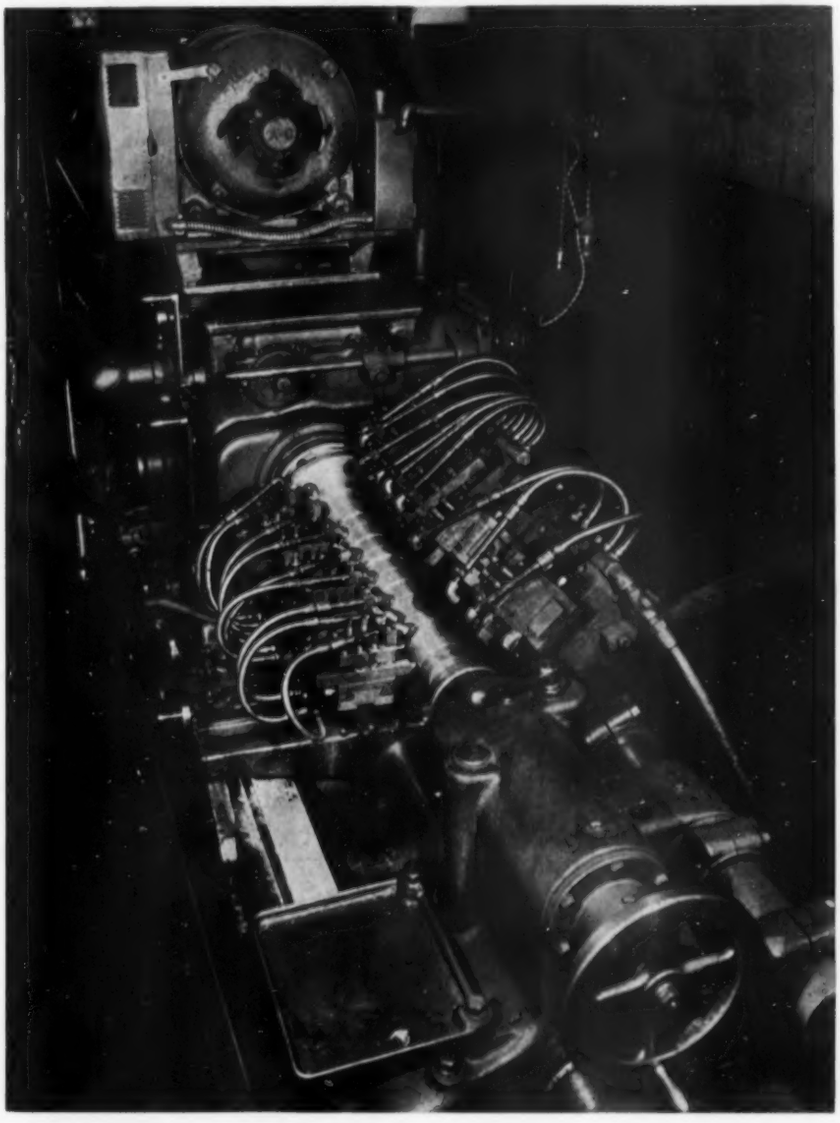
SPINDLES for Fay automatic lathes, turret lathes, and thread grinders manufactured by Jones & Lamson Machine Company all are made from SAE 1045 steel, heat-treated to 200-235 Brinell before machining. The forgings are purchased from the supplier rough turned all over, with approximately $\frac{1}{8}$-in. stock on a side to be removed from each outside surface. The hole inside the forging is reamed by the supplier to final size with a + 0.005 in., — 0.000 in. limit.

Not long ago Jones & Lamson developed an improved manufacturing procedure for machining these spindles. In order to illustrate this procedure, operations on the spindle for the 16-in. Fay automatic lathe are outlined. Procedure for the other spindles involve the same principles. When this sequence was put into operation, there were about 25 spindles in each lot; since that time the lot sizes have been increased to about 40 spindles.

The spindle for the 16-in. Fay automatic lathe has an American Standard flanged spindle nose, as are all work spindles for Jones & Lamson machines. In all, 23 operations are necessary to produce and inspect this spindle from the rough forging, and then to inspect it all over.

After a thorough inspection, the spindle forging is delivered to the spindle department for machining. Since the hole in the spindle has been finish reamed by the producer of the forging, expanding plugs are used in the first operation to provide centers for supporting and locating the spindle while three spots are ground on the stem of the forging.

Next, two turret lathe operations are used to prepare the spindle for the Fay lathe turning operations. In operation 2, the nose end of the spindle is rough machined, the small end of the spindle being gripped in a three-jaw chuck and the outer end being supported in a three-roll steadyrest.



Full advantage is taken of multiple tooling set-ups when machining J&L spindles. In this operation on a Fay automatic lathe, all stem diameters are turned and all shoulders are formed at one time

In operation 3 the stem end of the spindle is faced and centered, while the nose end is supported in a three-jaw chuck and the spindle is supported by a three-roll steadyrest. Next, the spindles are delivered to two 24-in. Fay automatic lathes where operations 4 and 5 are performed. For these two operations, the two lathes are run by one man. The flange end is roughed on the first Fay and the stem end is roughed on the second Fay lathe. In both set-ups the spindle of the lathe has a two-jaw eccentric driver, and the outer end of the spindle is supported by a revolving center in the tailstock of the lathe.

Following the roughing operations

on all the spindles in one lot, the tools on the lathes are reground and reset, and the spindles are run through a second time for operations 6 and 7, to get a finish cut on all outside surfaces. Again, one man runs the two lathes. Since the cutting time for an average 11-in. flange spindle is about 20 min., the operator has plenty of time to run both machines. As shown on the preceding page, finish turning on these spindles takes full advantage of multiple tooling set-ups. In the operation shown, all stem diameters are turned and all shoulders are formed at one time. This is the set-up shown at operation 7.

Finishing Operations

With the spindle completely turned and faced, there follows a series of grinding, milling, turning and drilling operations which are shown in the drawing. Care is taken not to remove an excessive amount of stock in one operation, as it is necessary to reduce the possibility of distortion to a minimum.

Green grinding of the outside surfaces, listed as operation 8, is performed in a cylindrical grinder, the spindle being supported on expanding plug centers like those used for operation 1. The three keyways are milled in operations 9, 10 and 11, using standard millers with high-speed steel cutters. Then, in operation 12 the nose end of the spindle is finish faced and formed in an engine lathe, the stem end of the spindle being centered and driven by a four-jaw chuck, and the spindle being supported by a three-roll steadyrest.

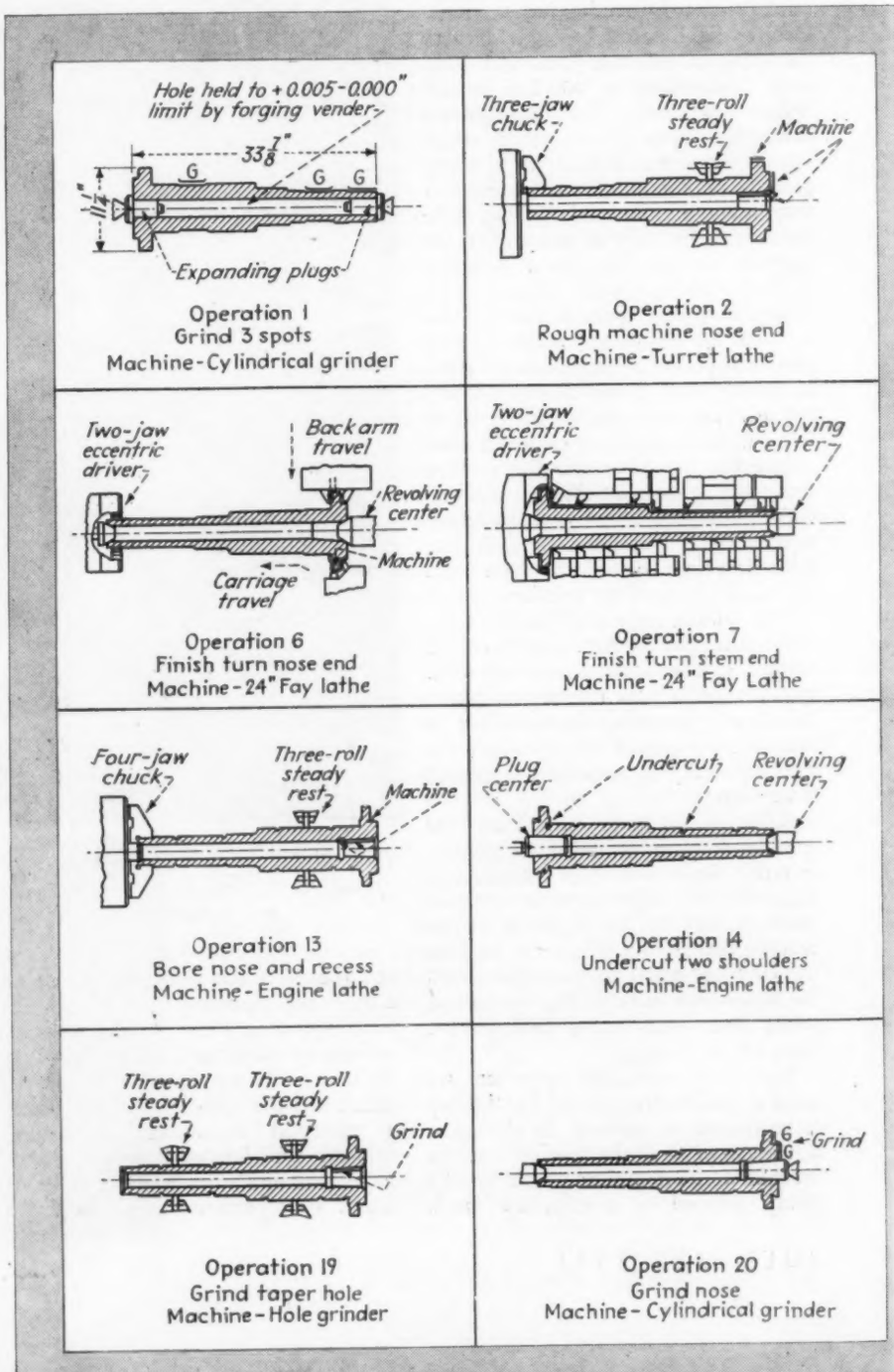
Operation 13 is another engine lathe job. Here, the nose is bored and a recess is turned. The set-up is the same as for operation 12. Operation 14, where the two shoulders on the outside of the spindle are undercut, also is performed in an engine lathe. Here an expanding plug center is fitted in the bored nose end, and the stem end is supported by a revolving center.

Although the spindles for Jones & Lamson turret lathes, thread grinders, and Fay automatic lathes vary somewhat as to individual dimensions, the manufacturing problem is fundamentally the same in all cases. The procedure illustrated is that used for machining a 16-in. Fay lathe spindle. Operations have been divided so that an excessive amount of stock is not removed in any one operation; this reduces the possibility of distortion.

A radial drill press is used for operations 15 and 16. Here a series of drilling, tapping, reaming and counterboring operations are performed at the nose end, and a small hole is drilled and reamed near the stem end in two set-ups. Next, a cylindrical grinder is used to finish the outside surfaces in operation 17. Again, expanding plug centers are used to support the spindle between the centers of the grinder. In operation 18 the spindle is set-up in an engine lathe for rectifying the center at the stem end. This lathe set-up is essentially the same as that used for operations 12 and 13, except that the spindle this time is gripped at the nose end. Next, the spindle is delivered to an internal grinder where the bore at the spindle nose is finished. Then, in operation 20, the outside surfaces at the nose end of the spindle are finished in a cylindrical grinder.

The grinding of the spindle threads in operation 21 has been highly successful in that it produces more accurate threads 47 percent faster than previous methods. In addition, the fact that the threads have a better quality finish makes assembly easier and more positive. The threads on all spindles are ground in two passes from the solid, in line with modern thread-grinding practice.

Following operation 22, where all outside surfaces are polished and burred in an engine lathe, the spindles are carefully inspected in operation 23, prior to delivery to finished stores. A



routine check on diameters, shoulder lengths, tapers, etc., is made and then the spindle is checked for runout. For this test, the spindle is mounted in two cast-iron cradles scraped to fit their respective diameters. The cradles are set on an angle, and a ball is placed in the center in the stem end of the bore. Gravity then holds the spindle in the two cradles and against the ball center for the runout check.

Indicators are placed at strategic points on the spindles as indicated. The limits shown are allowable runout limits, and finished spindles usually are well within these limits. The number of scrapped spindles has been reduced almost to the vanishing point since this operation procedure has been in operation.

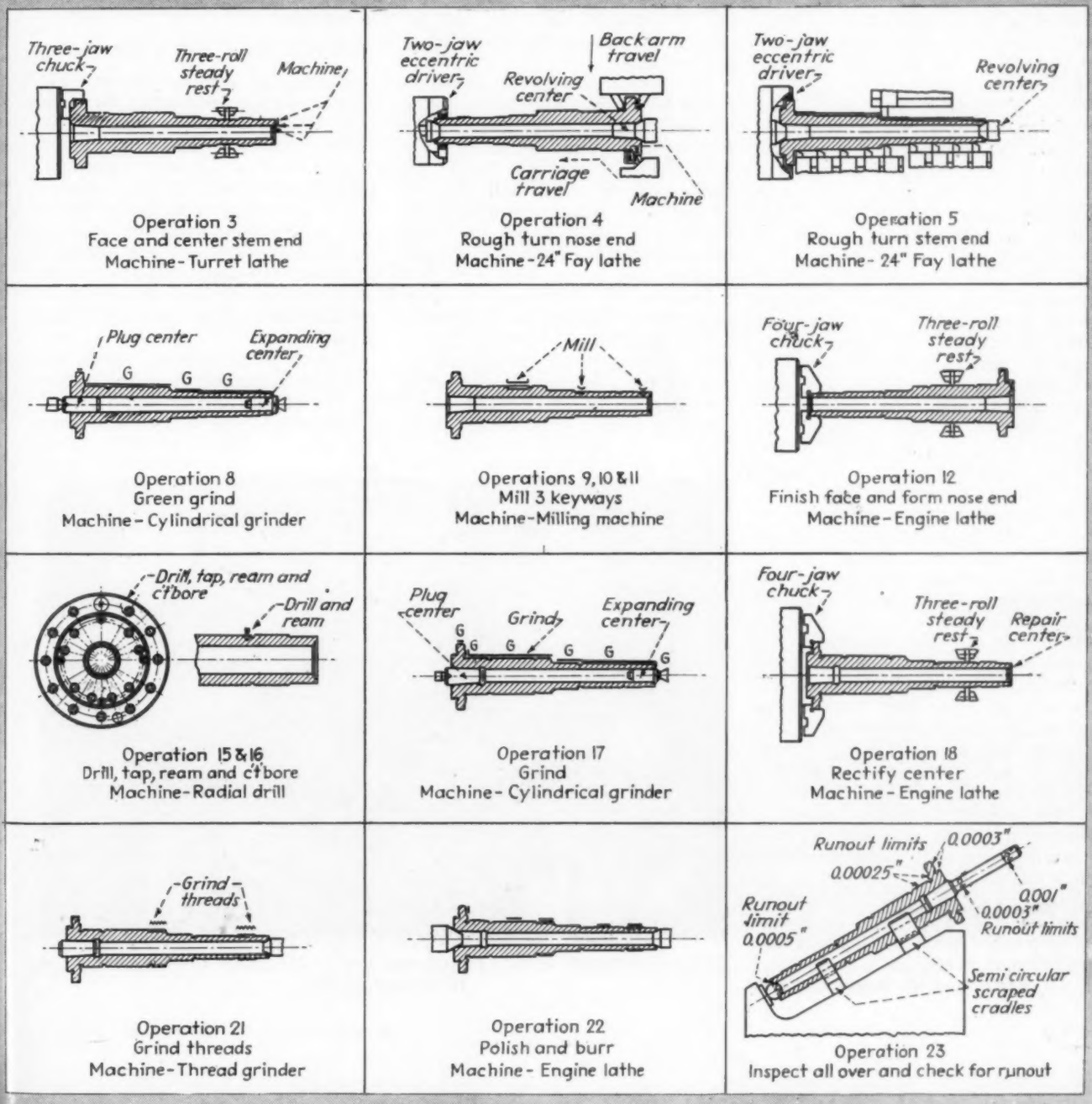
Colored Jig Bushings

SOME AIRCRAFT PARTS have literally hundreds of small holes. In line with modern production practice these parts, including rib, wing and fuselage sections, as well as control surfaces, cowling, bulkheads, instrument panels, are jig drilled.

Very often the design calls for groups of holes of a limited number of sizes. However, since all the holes are comparatively small, it is difficult to tell which is which just by looking at the jig bushing and it is extremely time consuming to refer continuously to the blueprint.

Aircraft manufacturers have remedied this difficulty by painting the jig bushing a distinguishing color for each drill size. A key giving the drill size and color is stamped at the end of the jig so that it is always available and quickly recognized when the jig is used.

As the holes are usually aligned in groups according to a given drill size, the jigs may be painted quickly by passing the brush over them. Any paint that gets into the hole is removed by the drill itself the first time the jig is used. Fixed bushings are used on such work. All the operator has to do is to find out from the key that the yellow bushings, for example, take an 0.065 in. drill and machine all the holes of this size before changing tools.



Adult Training Grows Up

The Adult Training School at Williamsport, Pa. was founded to relieve unemployment. Now it turns out thousands of machine operators for defense orders

IN 1930 OVER 10,000 unemployed roamed the streets of Williamsport, Pa., although a great many jobs were available. But the jobs required skilled men—men trained in machine shop practice—and the unemployed were untrained. Dr. George H. Parkes, a Purdue graduate and himself trained in machine shop practice, thought that the unemployed must and could be trained for the available jobs. The result was the Adult Training School at Williamsport, Pa.

Over 300 unemployed men enrolled in the school almost at once and over 1,000 in the first year. New shop buildings were constructed with CWA labor; the grading and foundation work was done by voluntary help. Idle machines were loaned by local manufacturers; condemned machines were given outright or sent to the shop to be repaired. Governmental agencies loaned a number of outmoded automatics to be overhauled and used in training work.

Today the vocational school, although primarily a department of the Williamsport High School, has classes in drafting, woodwork, sheet metal, welding and machine work of various kinds. Dr. Parkes has given it a wide field of usefulness. Classes are held for CCC boys; for those between 16 and 48 years who are handicapped by physical difficulties; and students ranging in age from 18 to 24 sponsored by the National Youth Administration. The school also maintains an aviation repair shop which is approved by the Civil Aeronautical Authority, and a night school for 40 hours a week. Students from all over the State are enrolled in the school.

All students must prove American citizenship. They must agree to continue training, with a 40-hour week as a minimum, unless released by the faculty or hired in a metal-working industry. The three shifts are 8 a.m. to 4 p.m.; 4 p.m. to midnight; and midnight to 8 a.m.

Dr. Parkes and his instructors, who are all practical shop men, keep in touch with the local shops. They determine the type of men needed, or are likely to be needed in the near future. Foremen from the shops indicate how many men they will need and what these men must be qualified to do.

On May 2, 1940 a special Emergency Training Commission was formed to direct the speeded vocational program made necessary by the U. S. defense program. Three weeks later the school shop went on a 24-hour schedule to meet an increased demand. The Training Commission consists of five men, four from leading Williamsport industries and another as a representative of the industrial workers.

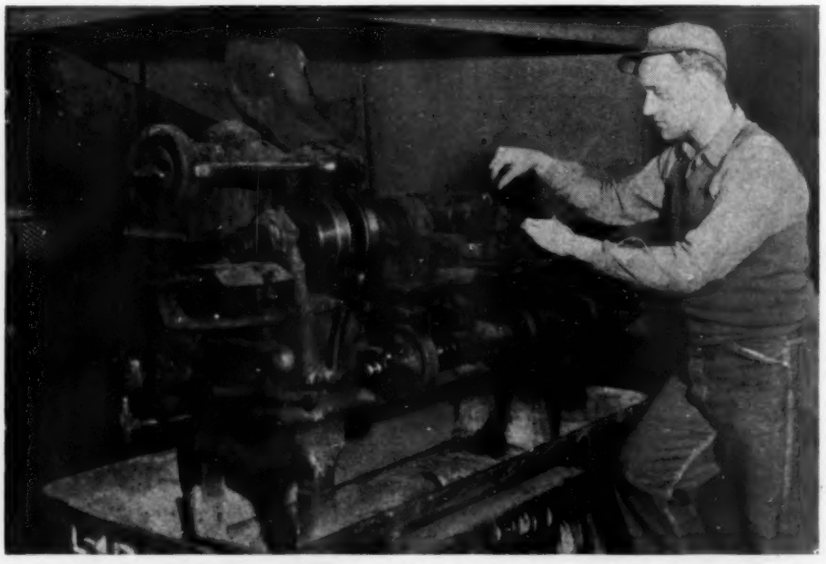
Plans are also being considered to handle whatever readjustments may be necessary when the emergency in the peak of employment has passed. For it is realized that those changes are likely to occur, which will affect us all and particularly the workers. The fact that this problem is now being considered gives promise of a better solution than in the past.

Some of the work comes from the local shops. Castings of valve bodies are machined and in the process it trains men who will subsequently be sent to the Darling Valve & Mfg. Company in the city. Aviation engines, in need of an overhauling are sent to the school for rebuilding. The aviation section is one of the most important in the school and renders excellent service in training the many airplane mechanics needed in the new defense program. The engines are disassembled, parts checked for wear and magna-fluxed for cracks. Repairs are made or new parts supplied if necessary. Then the engines are reassembled and tested. Such training is especially useful in Williamsport, home of the Lycoming engine and propellers. Skilled men trained in this way fit into Lycoming's inspection and assembly departments with a minimum of training required in the plant.

Welding Given Expert Attention

Welding, an important part of present day airplane construction for fuselage, landing gear, and other parts, receives expert attention. Student welders turn out a large variety of parts which are used in school equipment. Drawing board stands, tables and benches are made of airplane steel tubing. This not only provides light and substantial equipment, but also provides the kind of experience necessary in fuselage construction and repair.

The airplane assembly stands are designed so that the center of gravity of the engines on the stand is approximately in line with the trunnions



This old automatic will be rebuilt and used in the Adult Training School at Williamsport, Pa.

Lathe and bench work is done in most of the shop rooms

on which the revolving part is supported. This has proved very useful both in the school and in the engine plant itself.

In the training course men with no knowledge of mechanical drawing are taught to read blueprints. It is felt that, even if a man eventually becomes an operator doing no set-up work, a knowledge of blueprint reading will increase his chances of securing work, especially in smaller shops. It will also help a man become an inspector, as several from the School already have done. A student who can check a radial engine crankcase against a blueprint is splendid material for any inspection department.

The school machine equipment is not all that might be desired. But the thoroughly practical instructors are training men in the rudiments of a large variety of machine work. Some of the old automatics are being rebuilt and will be used to show the principles of machines of this type. Then, even if the shop to which the man goes has a different machine, he at least knows the fundamentals of such work.

Rebuilding machine tools is excellent practice from a number of angles. It provides a large variety of work, both flat and round, and indicates to the student the kind of fits necessary. In addition it gives a man the kind of experience that makes him valuable in any small or medium sized shop. Practically all except mass production shops have machine tools that should be overhauled periodically.

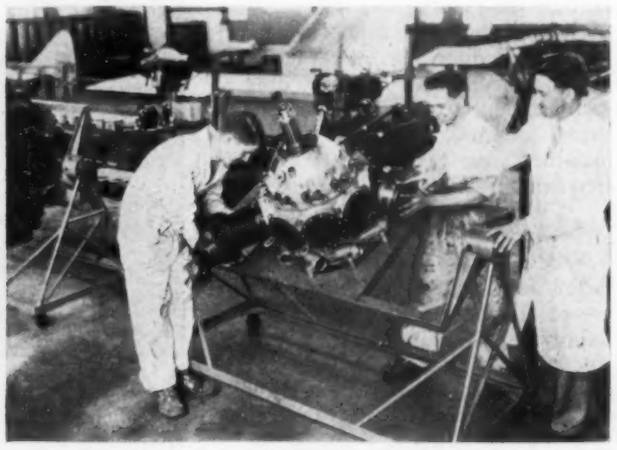
It is not claimed that skilled mechanics are trained in the school. However, promising boys and men can be trained in work that will help them become toolmakers. This tends to meet the demand which is already felt in many industrial centers. Every effort is made to provide a training which will make it easy for a man to fit into the work of any shop he may enter. Although only practice on a particular job makes one an expert, each student is taught, as far as possible, the underlying principles.

Although the soundness of the plan on which the school is based, the methods used, the instructor personnel provided, and the work being done, all satisfied the authorities, some shop executives were interviewed for their opinions. Every executive at the Lycoming Division, Aviation Mfg. Company, was pleased with the men trained at the Adult Training School. Several executives gave one or two examples of unusual excellence.

The usual term for emergency training at the Adult School is eight weeks. Although no one who knows shop work believes that thorough mechanics can be trained in such a short time, many people realize that there is a need for men trained for a short term in this emergency, even as we did in 1917–18. Both men and women with little or on previous experience can be taught to operate one or more production machines in a short term. Not many arguments exist to the contrary.

The Adult Training School does two essential things: it provides sound preliminary training which will aid greatly in getting maximum production from our machine equipment. Also men with little previous training are turned into self-supporting citizens, adding greatly to their morale and lightening the relief burden of the country.

Students watch a supervisor set up a valve casting in an engine lathe



Students overhaul an airplane engine on a stand designed and built by them

What Steels to Use

COMPILED BY J. G. MAGRATH, APPLIED ENGINEERING DIVISION, AIR REDUCTION COMPANY

One of the first considerations in flame hardening is the proper selection of materials to be used

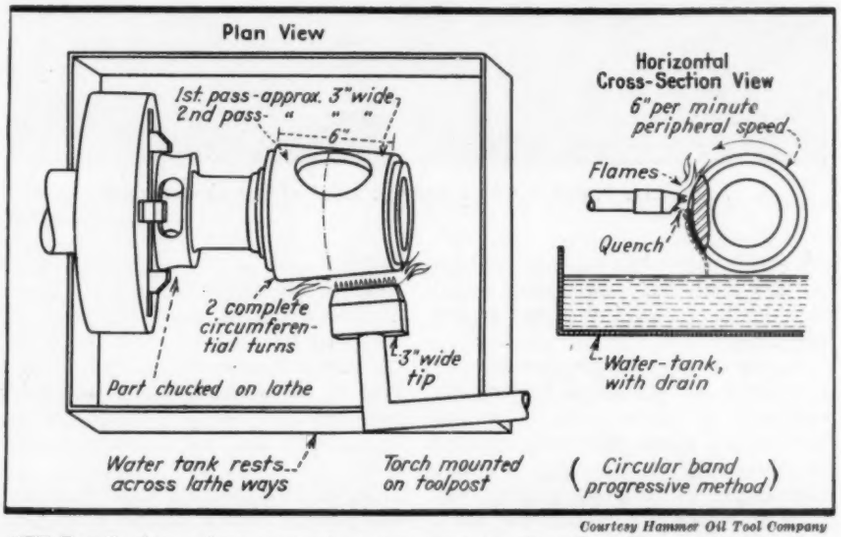
GENERALLY SPEAKING, steels that are hardenable by normal furnace heating and quenching may be flame hardened. However, care must be taken not to overheat coarse-grained steels as such treatment further coarsens the grain structure and may cause surface checking.[5] Fine grained steels are usually preferable, as their inherent tendency to resist grain growth is a safeguard against the results of overheating. Their shallow hardening characteristics are not a disadvantage because of the relatively thin layer to be hardened[2] by this process.

The use of steel of improper analysis for flame hardening may result in insufficient hardness or cracking from excessive hardening. The steel analysis should be adusted to comply with the process requirements. In many cases flame hardening permits substituting a plain carbon steel for an alloy steel. For furnace hardening large or complicated shapes, it is necessary to use alloy steels with low critical cooling rates so that the required hardness can be obtained with mild quenching; faster quenching rates may cause distortion or cracking.[4] Since only a small section of the part is heated in flame hardening, the use of rapid quenches with plain carbon steels is frequently possible.

Alloy Steels Give Tough Cores

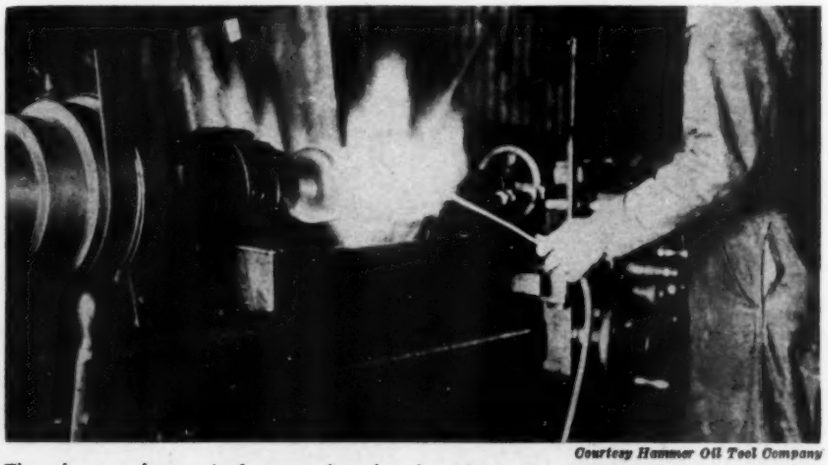
Where surface hardness is a primary factor, no advantage is found in the use of alloy steels.[8] However, where improved physical properties of the core are desired, the alloy steels are frequently employed despite the fact that plain carbon steels provide the desired surface hardness.

While the SAE code does not cover all of the flame hardenable steels, it



Courtesy Hammer Oil Tool Company

"EZ Turn" plug valves *control rotary mud in oil-well drilling and function under 2000–8,000 lb. per sq.in. Formerly made of SAE 4140 steel, the plugs frequently galled and scored. SAE 1040 steel is now used and flame hardened. The plug is chucked in a lathe with the torch and tip mounted on the carriage. The plug is revolved at 6 in. per min. past the flame which gives complete surface hardening in two complete turns*



Courtesy Hammer Oil Tool Company

The sharp edges *of the opening in the plug are prevented from melting during the flame hardening operation by means of an auxiliary manually controlled water quench. A water tank with a drain resting on the lathe ways disposes of the quench water. The plug is ground after hardening. Flame hardening has entirely eliminated galling*

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includes a sufficient number of proper analyses which may be employed directly, or as a guide for more specific selections to meet certain requirements. Those suitable for flame hardening are indicated in Table III.

Carbon is the most active element affecting the hardness of steel. Increasing carbon percentages in steel result in increased hardness and tensile strength and diminished ductility.[4]

Table III

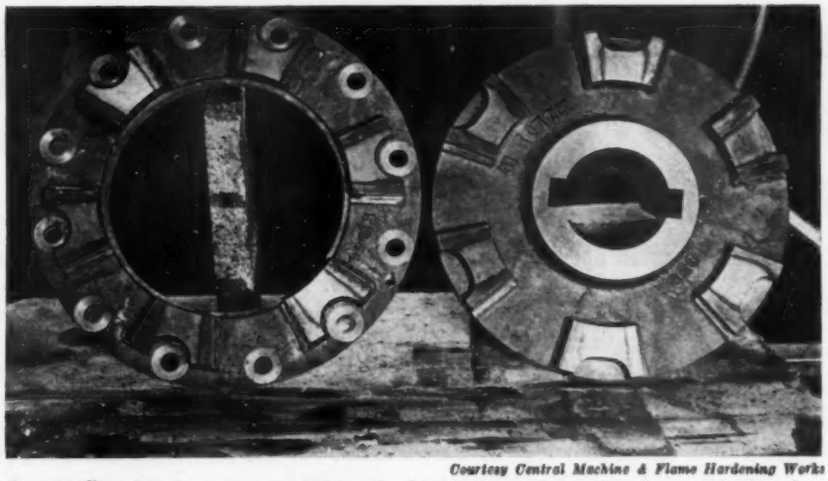
Type of Steel	*SAE No.*
Carbon	1035— 1060
Free Cutting	X1335—X1340
Manganese	T1335—T1340
Nickel	2330— 2350
Nickel-Chromium	3130— 3140
Molybdenum	4135— 4150
Chromium	5140— 5150
Chromium-Vanadium	6135— 6150

Table IV—PLAIN CARBON STEELS

Classification	Analysis C	Mn	Si	Brinell Hardness* after Water Quench
SAE X1335	0.35	1.45		500
SAE 1040	0.35	0.80	0.30	580
SAE 1045	0.48	0.68	0.18	630
SAE 1050	0.46	0.69		615
SAE 1055	0.55	0.74	0.22	712
SAE 1095	1.00	0.30		700

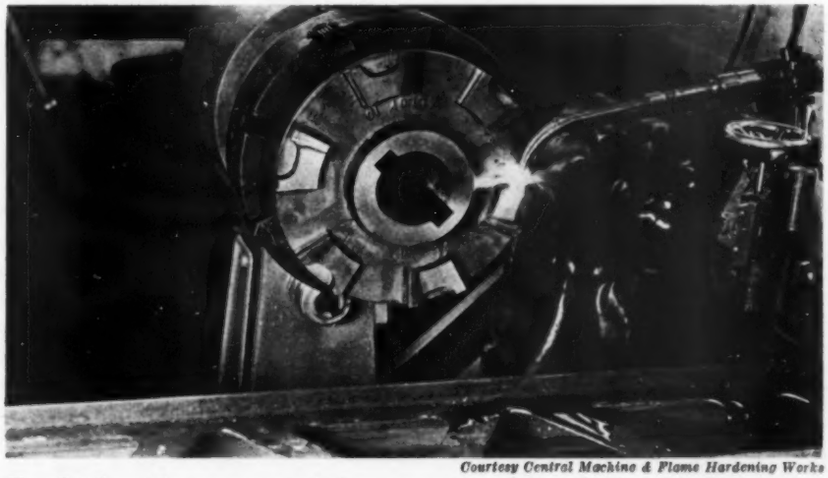
***Hardnesses as shown are not indicative of maximum hardness obtainable but are representative of flame hardening results using varying quenching rates to meet specific hardness specifications.**

In general the maximum hardness obtainable from a steel of given carbon content is dependent on the carbon content and is unaffected by the presence of other alloys. The effect of these other alloys manifests itself largely in the relative ease with which steels can be hardened, and this characteristic of a steel is generally termed its "hardenability."[1]



Courtesy Central Machine & Flame Hardening Works

Caterpillar tractor *power take-off clutches used on lumber and logging equipment are made of steel foundry alloy No. 10 containing about 0.45 percent carbon. The clutch jaws are flame hardened by the flat progressive method. A standard welding torch is mounted on a traveling radiagraph.*



Courtesy Central Machine & Flame Hardening Works

The clutch castings *are mounted on any convenient spindle with the wearing edge of one of the jaws horizontal. A standard two-flame tip provides the heat, while an improvised copper quenching tip supplies the water. The tips are carried along the wearing edge. On the completion of one surface the casting is indexed to present the next jaw. Hardening time per casting is about 15 min.*

Flame hardening may be applied successfully to all SAE carbon steels of 0.35 percent carbon or greater. The best carbon range appears between 0.40 and 0.60 percent employing a water quench. Hardnesses of 400 to 650 Brinnell are obtainable depending upon quench severity. With carbon in higher content than 0.70 percent, the rate of heating and rate of quenching must be carefully regulated to avoid surface checking.

While pressure water quenches are generally employed on 0.40–0.60 carbon steels for steels of 0.70 per cent carbon cnotent or higher, milder quench media such as compressed air or compressed air-water mixtures are recommended.

The SAE 1040 and 1045 steels have proved suitable for flame hardening. The effect of grain size on the flame hardening properties of plain carbon steels has been investigated. As a check, two SAE 1045 steels of close chemical compositions but of ASTM grain size 2–4 and 6–8, respectively, with corresponding deep and shallow hardening characteristics, were investigated and found to react to the process in an identical manner.[11]

A group of SAE carbon steels, successfully flame hardened, is shown in Table IV.

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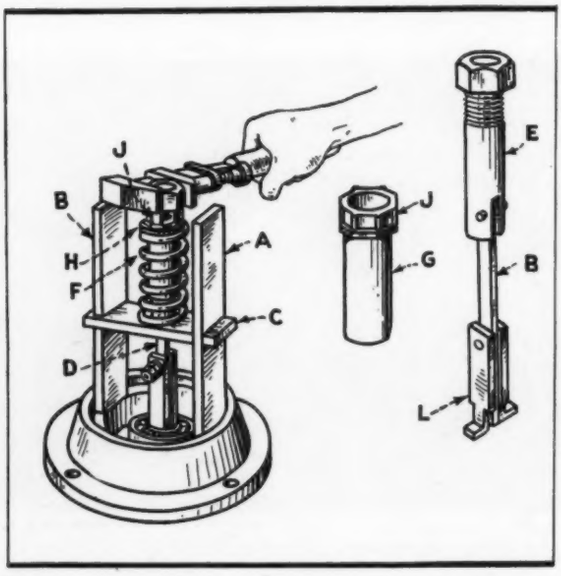
Part 4 of this series on flame-hardening will appear in an early number.

IDEAS FROM PRACTICAL MEN

Compression Spring Improves Bearing Puller

BY W. E. ABBOTT

Once a bushing or bearing starts to move when pulling it from the part in which it has been inserted, removal will be speeded if some means be devised to keep it moving. This is the purpose of the device shown in the drawing. It was designed for use on small turbo-generators which have two-part bushings and a bearing that serve as packing to prevent steam from leaking. These parts are so located that they can-



When the spring has been tightened on this bushing puller, the bushing is started and the spring keeps it moving until completely removed. The stand can be assembled and disassembled quickly

not be driven out with any tool without being damaged. If damaged they cannot be used again.

The puller has two legs *A* and *B* of ½x2½x9-in. flat iron space 4 in. apart. They have ½-in. notches cut half way through their width into which a cross piece *C* of ½x2½x6-in. flat iron is inserted. This cross piece has 1x1¼-in. notches on 4-in. centers, which match the notches in the legs *A* and *B*; while the legs and cross piece engage freely, they form a rigid stand when in place. A ½x1-in. hole is cut in the center of *C* for insertion of the wedge *D*.

The top of the wedge *D* enters a slot cut into the 1x5-in. stud *E* where the wedge is held by a ⅜x1-in. pin. A spring *F* of ⅜-in. round steel is 4 in. long and fits over the stud *E* with a clearance for a 1-in. pipe nipple *G* over the stud and inside the spring. A locknut *H* and bushing *J* screwed on nipple *G*, rest on the end of the spring and bear against it when the nut *K* is tightened. Pressure thus applied to the spring lifts the stud, wedge and legs *L*, the latter of which have offset shoulders or toes that fit under the bushing or bearing that is to be removed.

It can be seen from the drawing that the cross piece *C* is not at the center of the legs *A* and *B*. By turning the stand end for end, it may be used for two different heights. The author uses two other legs, to replace *A* and *B*; these have notches cut at intervals, which make it possible to vary the height of the cross piece *C* and cover every use he has devised for it.

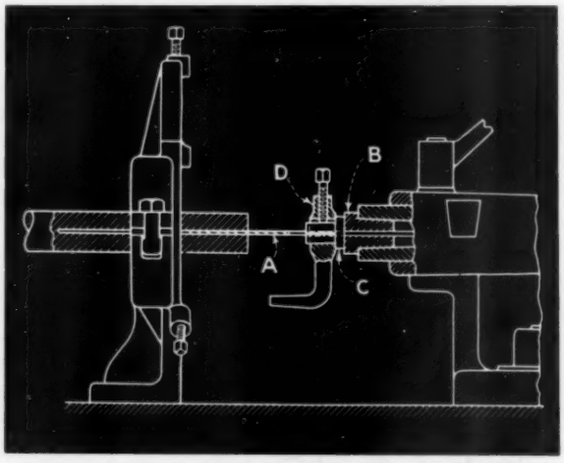
The legs *L* are made in pairs, one pair for every stand height available.

A Tip on Drilling Long Small Holes

BY ARTHUR SILVESTER

Recently we found it necessary to drill ⅛ in. diameter holes, 10 in. long in two hard-steel shafts, 12 ft. long. A heavy-duty lathe was the only one available for this work, and the piece was chucked and supported in a steady rest in the usual way. The ⅛-in. drill was held in a drill chuck in the tailstock, and fed into the work, using lard oil as a lubricant. Several drills were broken, and far more time was consumed than should have been necessary before the first piece was drilled.

The same set-up was used for starting the hole in the second piece, using a short drill. However, the following set-up was used for completing the hole. A long drill *A* was selected, and to this we welded a long piece of ⅛ in. drill rod. This drill was set in



This long drill, held by a slit brass bushing and a lathe dog, can be advanced slowing into the work for drilling long holes

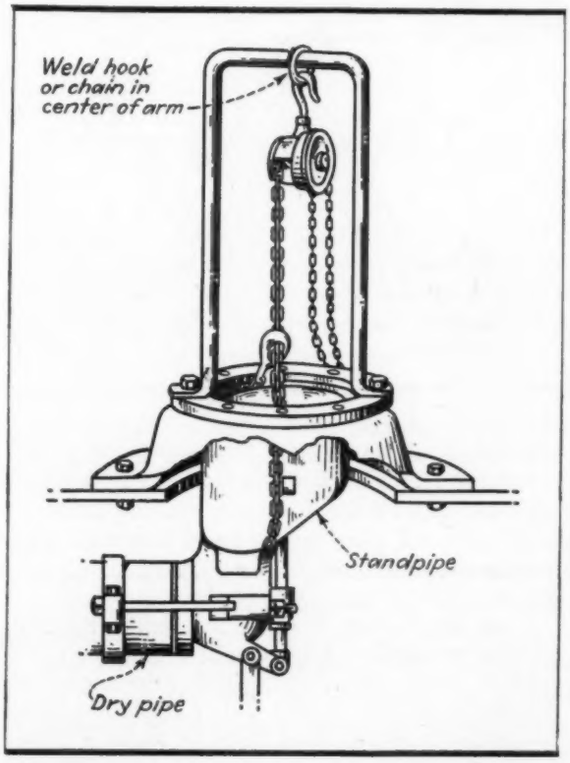
socket or sleeve *B*, which was tapered to fit the tailstock quill, and drilled centrally with a hole for a sliding fit of the ⅛ in. drill. A split brass bushing *C* was then slipped over the drill and locked thereon by the driving dog *D*.

The drill was fed slowly into the piece, holding the dog by hand. There was no danger of injury to the operator, since the drill is of such small diameter. By withdrawing the drill after every 1/16 in. advance, and blowing away the chips, we were able to drill the 10 in. hole in one hour, as compared with several hours on the first piece.

Removing Throttle Valves With Chain Falls

BY ARTHUR HAVENS

Removing and replacing heavy locomotive throttle-valve standpipes is a job that can best be done with a chain falls; however, the enginehouse is seldom equipped with facilities for hanging such a chain falls.



A U-frame bolted to the locomotive steam dome supports a chain falls, thus simplifying greatly the removal of throttle-valve standpipes

Usually the machinist has the locomotive moved until the steam dome comes directly under a heavy roof beam, and it is here he fastens the falls, regardless of the inconvenience and time involved in doing it.

The men in charge of this work in our enginehouse designed the frame shown in the drawing, which is bolted directly to the dome. A length of 1½-in. pipe is bent into a U-frame of the proper height with the legs spaced to cover the average steam dome. The ends are flattened and drilled large enough to fit easily over the largest steam-dome stud. A short piece of chain or a steel hoop is welded to the top arm of the frame onto which the chain falls can be hooked.

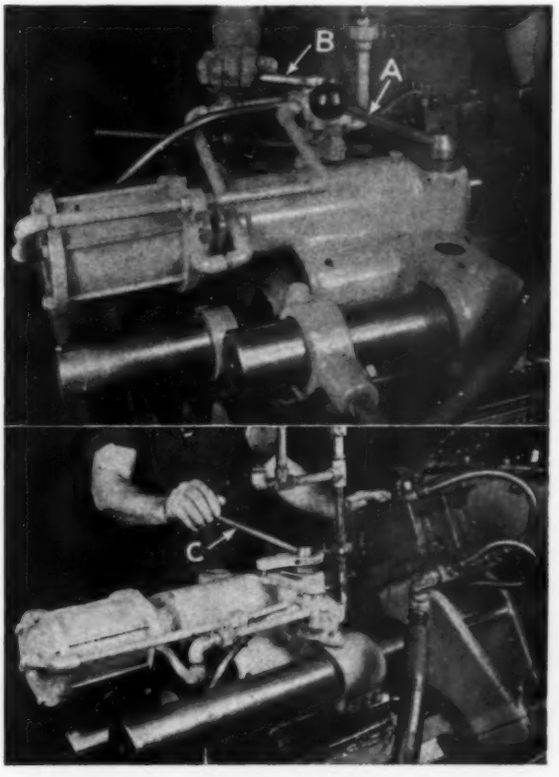
Time Saved By Reducing Tailstock Operations

BY O. W. HABEL

Motion economy in manufacturing operations is no longer a new thing, but it is often overlooked unless the many savings effected by such studies are constantly kept in mind. The main principles to be remembered are:

1. Eliminate all unnecessary movements of the workman.
2. Shorten and simplify all necessary movements.
3. Balance the work.
4. Minimize the use of the eyes.
5. Eliminate the use of hands as holding devices.

These principles can be applied in the following ways: (a) Replace hand movements by mechanical movements. (b) Replace hand movements by foot or knee movements. (c) Eliminate the passing of work, tools or controls from one hand to the other. (d) Combine movements by providing controls with multiple functions. (e) Provide for drop discharge of finished work. (f) Keep movements within normal work



Top—Two levers are required to operate the tailstock; one to clamp it and one to move it. Bottom —Both operations have combined by moving one lever, giving a six per cent saving

space. (g) Eliminate barriers. (h) Arrange for getting and disposing in adjacent locations. (i) Eliminate wait of one hand. (j) Keep both hands busy with useful work. (k) Eliminate hard to find controls and avoid small buttons. (l) Keep necessary use of eyes within minimum area. (m) Aid locating by use of bell mouths and bullet noses. (n) Eliminate use of hands for holding machine part. (o) Eliminate use of hands for holding work.

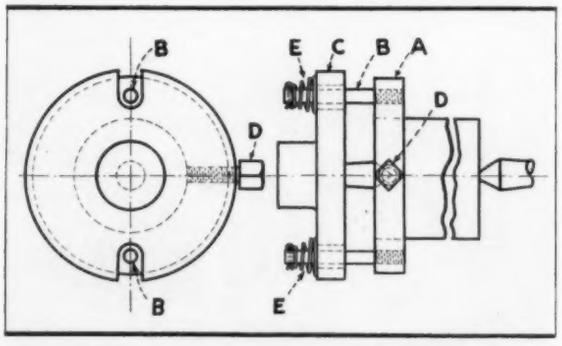
An excellent example of the application of principles 5d and 5g is shown in the illustration. In this operation, turning a Pitman shaft, the machine as originally arranged required the operator to handle both levers *A* and *B* to operate the tailstock; *A* clamped and unclamped the work, while *B* advanced and retracted the tail center by compressed air. By arranging the clamping lever to also operate the air valve, the operator now handles by one lever *C* and it is easily accessible. This change resulted in a six per cent labor saving.

Lathe Dog That Can Be Set Quickly

BY PETER VEIT

While operating a No. 12 LeBlond Multi-Cut automatic one of my first jobs was turning some crane axles from stock $4\frac{1}{2}$ in. diameter and 10 in. long, each of which weighed 45 lb. This, together with a conventional lathe dog weighing $4\frac{1}{2}$ lb., made the work very inconvenient to handle. Therefore, I devised the lathe dog shown in the drawing which permits setting the work on centers before clamping or removing the dog.

It consists of a steel ring *A* $1\frac{1}{4}$ in. wide and $7\frac{1}{4}$ in.



This lathe dog is a part of the driving plate and permits the work to be placed on the centers before the dog is tightened

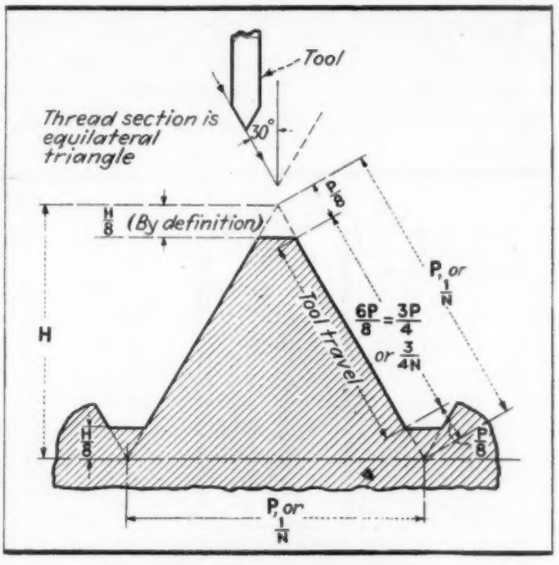
diameter bored to slip over the rough stock. Close to the outside edge of this ring holes are drilled and tapped 180 deg. apart for $\frac{5}{8}$-in. driving studs *B*, which slip through the driving plate *C*. The length of studs *E* is controlled by the length of the headstock center.

The dog is shown in its driving position in the drawing. Plate *A* is clamped to the work by setscrew *D*. Releasing the setscrew causes compression of springs *E* to pull ring *A* against the driving plate *C* leaving the center exposed for easy removal of the work of this kind.

Tool Depth For Threads Easily Calculated

BY LAURENCE F. SOUTHWICK

When cutting 30-deg. threads on a lathe, the tool depth can be calculated by adding one zero in front of the pitch and adding to this dimension the depth of the thread. For example, with a nine pitch thread, the pitch is 0.111 in., to which is added the zero to obtain 0.0111 in. This, plus the depth of the thread,



By transferring all dimensions in terms of H *to the equivalent dimensions in terms of* P, *or its equal* 1/N, *yields the tool travel as* 3/(4N)

which is 0.0721, gives the tool travel as 0.0833. This method was described by George J. Schmidt (*AM*—Vol. 85, page 555).

I use the formula 3/(4*N*) for getting the tool travel when advancing the tool at a compound rest angle of 30-deg. In this formula *N* is the number of threads per inch to be cut. This formula has many advantages over the other. First, it happens to be rigorously accurate, since it does not involve 0.866 (cosine of 30 deg.) used to find the depth of thread. Next, it does not require either thread depth nor pitch figures, as Mr. Schmidt's does. All that need be known is the number of threads to be cut, and in many cases the mathematics can be done mentally. Examples: For ten threads, the formula 3/(4*N*) becomes 3(4x10) or 0.075 in. For fifteen threads it becomes 3/(4x15) or 0.050 in.

Memorizing this formula will entirely obviate the need of any tables for cutting any thread. Simply multiplying the figure for tool travel by 0.866 will give the thread depth.

Armament

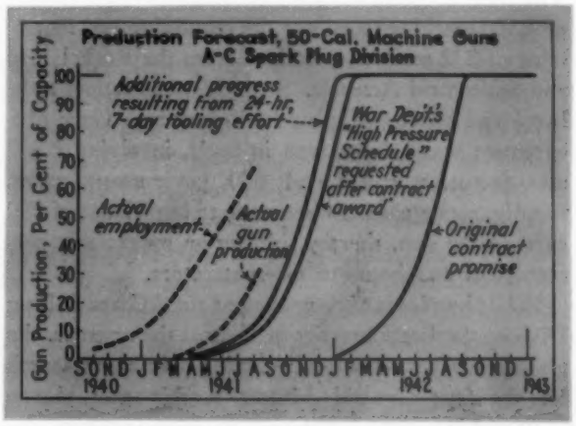
SECTION OF AMERICAN MACHINIST

FROM MOTOR CARS TO MACHINE GUNS

MASTER MECHANICS and manufacturing engineers in the General Motors' machine-gun plants do not profess to be gun experts. Handed the job of making cal. 0.30 and cal. 0.50 machine guns in mass-production quantities, they immediately sought the assistance of the arsenals, gun plants like Colt, and the machine tool builders. That the AC Spark Plug and Saginaw Steering Gear Divisions commenced actual production ten months ahead of schedule is based upon the help received from these sources, plus the ability to set up large manufacturing operations in a hurry. The Frigidaire and Brown-Lipe-Chapin plants have followed the same procedure and will produce their first guns this summer.

Plans were made to tool up by conventional methods for perhaps two-thirds of the daily production required under initial contracts, and to use the time available before that production level could be reached to develop new methods for mass production. Some gun-making operations have not undergone much change for many years because production quantities would not warrant the expense of development programs and new high-production machinery. General Motors' machine-gun plants have attacked a number of conventional methods in order to speed output and save labor, the last becoming increasingly important because of potential labor shortages. Marked gains in production have already been obtained on certain slow operations through the application of automotive technique. Some trouble may be experienced with the new methods, but as machining problems they are no more difficult than jobs encountered from year to year in the automotive industry. Part design changes have also been made with the approval of the War Department, when it was found that application of new techniques would save operations and produce an equally satisfactory or better product.

Since the Colt Patent Fire Arms Company was already in mass-production on the cal. 0.50 gun assigned to the AC Spark Plug Division, the eastern concern cooperated with the Flint plant by supplying tool and fixture drawings. Some of these drawings were al-



AC Spark Plugs Divisions' dramatic achievement of machine-gun production ten months ahead of schedule exceeds even the "high pressure schedule" advocated by the War Department after signing the original contract in September, 1940. Saginaw Steering Gear Division can show similar progress

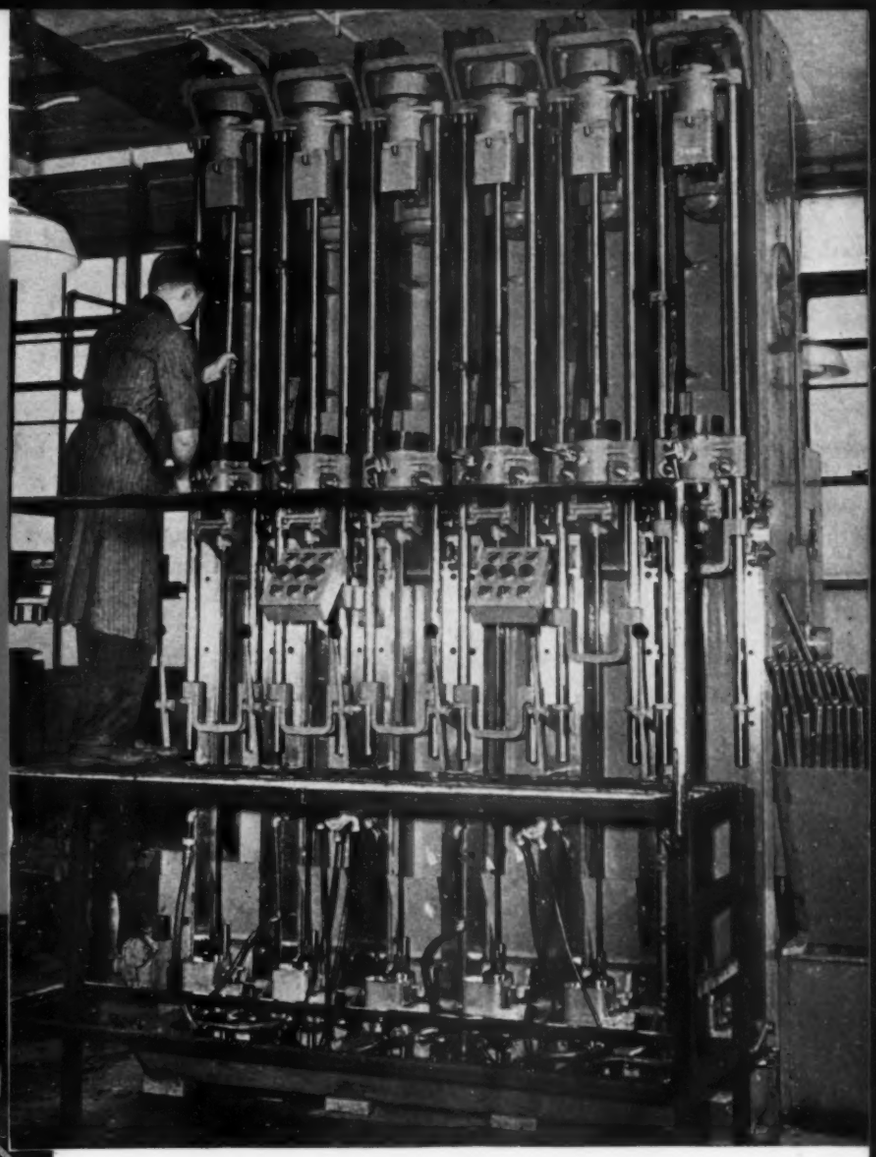
First conveyorized final-assembly line in the United States for machine guns. AC Spark Plugs expects that installation of materials-handling equipment in this department will save an appreciable percentage of the man hours ordinarily expended

Rough bars, purchased approximately to length, are milled to length in two stages and center drilled on this five-station, drum-type Davis & Thompson machine. Bars are supported close to the ends and at the center by three recessed drum disks and clamped by link chains, in such a manner that drilling coincides with the bar axis

tered, new ones were made when it was necessary to choose a different method for the quantities involved. The initial tooling-up problem involved the purchase of 1,300 machine tools, and the rebuilding and motorizing of 332 machines obtained from the Rock Island and Springfield Arsenals. Some 5,913 tools had to be listed and purchased, plus 1,446 fixtures. Gage procurement was a large item in itself, involving 2,960 manufacturing gages and 600 government gages. Finally, arrangements were made to buy 97 out of 290 parts in the gun, thereby shifting an appreciable percentage of man-hours to sub-contractors.

While hundreds of operations at the AC Spark Plug Division duplicate practice at Colt or the arsenals, the plant is serving as the focal point in production research for the four General Motors machine-gun plants. Scattered throughout the various manufacturing departments are numerous examples of how the automotive background changes production methods when production quantities warrant. Its influence is most strongly shown, however, in the barrel-manufacturing department. Conveyors have been installed to save fatigue and work handling. Cemented-carbide tools are being utilized 100 per cent for barrel turning and experiments are under way with the hard cutting materials for gun-barrel drilling, rifling and eventually broaching. As stated previously, adequate equipment of the conventional type has been installed to handle rising production demands for months to come. The sequence of operations with this equipment follows Springfield Arsenal practice. Attention will be confined to the new methods and machine tools developed for gun barrel drilling, reaming, broaching the bore and rifling, and chambering.

Barrels for cal. 0.50 guns are 36 and 45 in. long and turned from $1\frac{3}{16}$-in. heat-treated bars having a hardness of 280–310 Brinnell. Lo-Swing and Fay automatic lathes of the type conventionally used in gun



First installation of its kind, this vertical W. F. & John Barnes gun-barrel drilling machine portrays the automotive influence, fits into a conveyorized background. Each of the spindles is independent in operation. Experiments are being conducted with Carboloy-tipped drills with the idea of eventually cutting drilling time by 50 percent

An innovation in Magnafluxing rough-turned bars is the supply of fluid in finely divided streams, a time and labor saving feature. Fluorescent lighting of high candlepower assists the operator in finding cracks or flaws

work are employed. AC Spark Plug has standardized upon cemented-carbide turning tools for the roughing and finishing operations, in order to increase output, decrease tool changes and tool cost. Cutting speeds of 200 ft. per min. are standard, and tool settings are approximately 4½ to 6 in. apart. Cemented-carbide-tipped tools at $4.50 each are said to be cheaper than solid tools made from high-speed steel and the hourly output is four to five times greater than with steel tools. On the rough-turning operation, the hourly output averaged over the shift is approximately 20 barrels, while on the finishing operation, nearly 25 barrels are secured. High-quality finish is obtained, and no straightening is needed. In fact, less than one per cent of the barrels require straightening at any point in the production sequence. Forgings will soon be used for both barrels to save one rough turning operation as well as material. Experiments are also being conducted with forging the tapered section of the barrel, leaving 0.010 in. for cleaning up, and saving numerous additional machining operations.

A considerable number of conventional horizontal gun-barrel drilling machines were installed immediately at the Flint machine-gun plant, in accordance with AC's policy of providing ample production facilities of the proved type. To experiment with new high-production equipment, two W. F. & John Barnes six-spindle upright machines have also been put into operation, and four more ordered. At present these machines, which face each other, are served by an operator standing on a platform some distance from the floor. The machines tower almost to the ceiling, and it is necessary for the machine tender to be able to work at various levels. Hence it is planned to install a hydraulically elevated platform, so that he can raise himself quickly to the upper position for loading and unloading barrels, then drop to the lower position to remove the drill or inspect it. Barrels are picked off

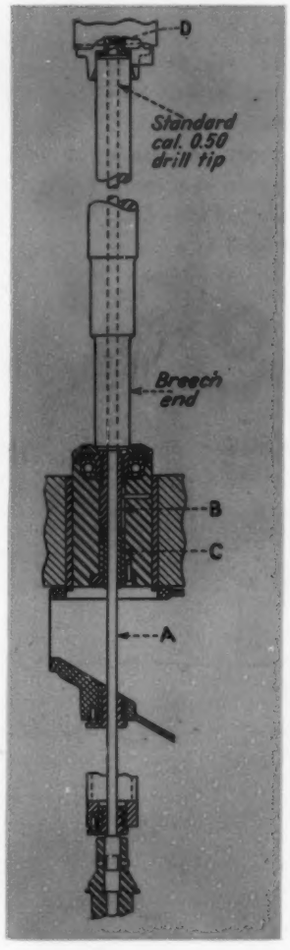
the conveyor which loops around the gun-barrel turning and drilling department.

When two Barnes six-spindle machines are set up facing one another, 85 per cent of the floor space required for twelve horizontal single-spindle machines is saved. The operator walks about on the small platform, easily observes the progress of drilling on any of the twelve independent spindles, and production is naturally speeded up in the automotive manner. Each spindle is individually controlled by pushbuttons at that station. After loading the work, the operator pushes the buttons to cause the particular spindle to go through its hydraulically controlled automatic cycle of rapid approach of the revolving barrel to the stationary drill, drilling, rapid return and stop. A feature of the "closed" hydraulic feeding system is that chatter is avoided because the work will not jump when the drill encounters hard or soft spots, and furthermore the drill can be withdrawn from a partially drilled hole and returned to the cut without ill-effect.

To load a given spindle, the operator inserts the muzzle end of the barrel in a three-jaw self-centering chuck in the headstock, which is integral with a slide at the upper part of the machine. Automatic actuation is provided for the chuck. The breech end of the barrel is held in a 120-deg. cone center in the tailstock. The tailstock is clamped to tie bars that are connected to the headstock, so that headstock and tailstock move down as an integral unit.

A stationary single-lip drill is held in a toolholder mounted on a slide near the base of the machine. The revolving barrel is fed down over the drill, which is caused to cut a true start by a long bushing in the tailstock. Three essentials must be observed with respect to the bushing: (1) Looseness of the non-rotating drill in the stationary bushing must be avoided, or the tool will run out, and hence a fit in the order of 0.001 in. maximum must be maintained, (2) the bushing must be held tightly against the breech end of the barrel by heavy spring pressure to prevent accumulation of small chips and escape of cutting oil, and (3) a back taper of 0.0004 to 0.0008 in. on the drill bit is required to keep clearance at a minimum in the bushing until the drill has cut its own path. When the drill breaks through the muzzle end of the barrel, it enters a steel plug behind the chuck jaws, thus preventing escape of cutting oil.

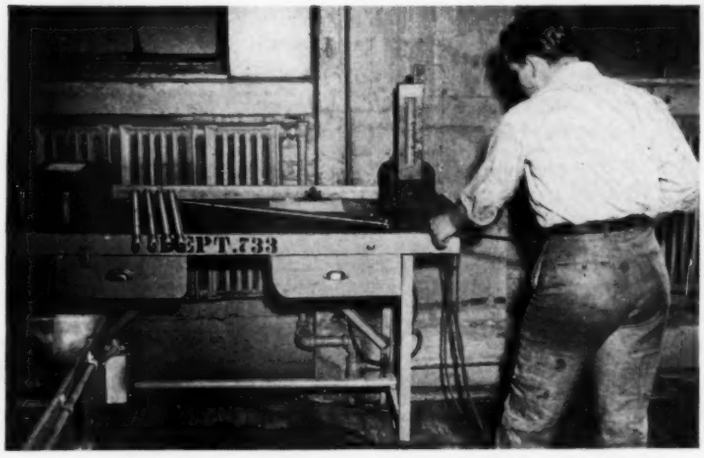
Each of the spindles is individually driven by its own cartridge-type motor through V-belts. On the first machine, five spindles were supplied for 1,100 r.p.m. to accommodate high-speed gun drills, while the sixth had a speed of 1,800 r.p.m. for experimentation with tungsten-carbide tipped tools. The Carboloy Company and the H. R. Krueger Company were called in by AC to develop tool design and procedure. Encouraging progress can be reported but it may be some time before barrel drilling with carbide tools becomes a thoroughly evaluated process.



At each spindle of the Barnes machine, the muzzle is held in a three-jaw self-centering chuck at the upper, or headstock, end and the breech is centered and clamped by a 120-deg. cone in the tailstock. Gun drill *A* has a 0.001 in. fit in guide bushing *B*. Spring *C* keeps the bushing tightly against the breech to prevent escape of cutting oil and chip lodgement. Loose piece *D* prevents oil from escaping and steadies the drill when it breaks through the muzzle end. Run-out normally is held to less than 1/32 inch

Experimental set-ups have involved considerable variation of cutting speed. Some carbide drilling has been carried out at 1,700 r.p.m., and occasional tests made at 2,400 r.p.m. with good results. Vibration of the barrel does not cause drill run-out, but this vibration in combination with whip of the gun-drill oil tube, induced by column action arising from heavy cutting pressure transmitted to a light-walled tube, has posed a number of problems. Whip of the oil tube is the factor limiting the feed on all types of gun barrel drilling. Experimentation has been done with various grades of cemented carbide, with the most recent trend toward the hardest grade. H. R. Krueger is developing a stiffer oil-tube construction. Several modifications have been made in tool design, including a change from the conventional grind in order to secure more free cutting action. With production lots of new drills, tests will be carried out at 1,250 r.p.m. Successful attainment of higher speeds such as 1,700 or 2,400 r.p.m.

Time is saved on the first and second rough-reaming operations by the concentration of effort at this twelve-spindle Baush machine. The barrel is held in a carriage and pulled upward and over the push-type reamer. At the top of the stroke, the reamer is stopped automatically and the barrel drops down over the tool to the original position



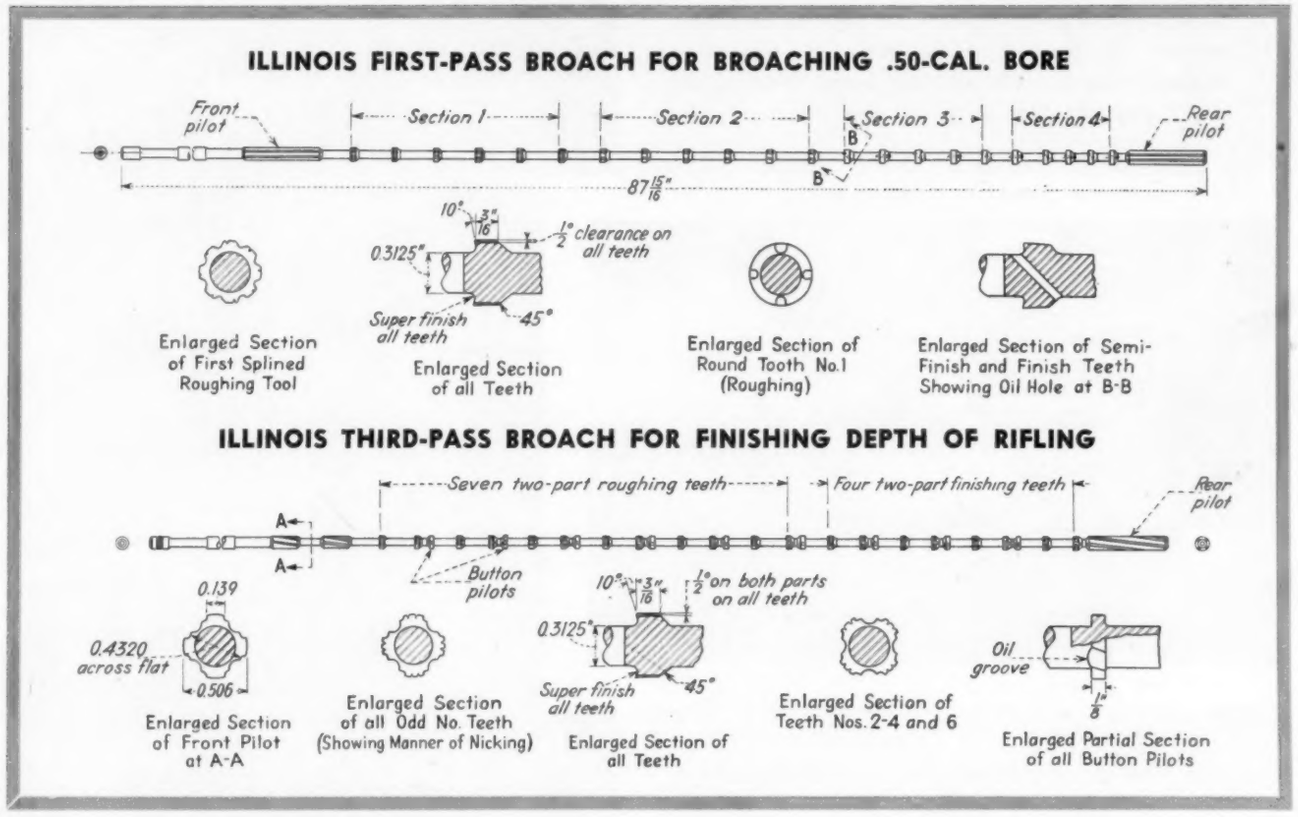
After final reaming barrels are inspected by holding them vertically over floor lights, thus saving fatigue. Occasional barrels show a "drill ring" and the barrel is checked with a Sheffield Precisionaire gage. Compressed air escaping from the orificed gaging head discloses bell-mouth, out-of-round or taper

in production, with a parallel gain in feed rate, which is desirable with carbide tools, depends upon whether further modifications in tool design or setup are involved. Some type of vibration dampener upon barrel or gun-drill tube, or on both, may prove necessary.

Tipped gun drills have a piece of Carboloy about 1 in. long brazed to a tool steel section approximately 2½ in. long, the tool steel being brazed to an oil tube. The tool has a 0.0004 to 0.0008 in. per in. back taper from the tip. The tool-steel section of the tip will have a hardness of 50–55 Rockwell to prevent galling when passing through the close-fitting hardened guide bushing.

Drilling results have been extremely variable with both types of tool materials, although carbide tips have shown a four- to five-fold advantage in number of barrels per grind. Some high-speed steel tools have drilled several barrels before dulling, others have drilled only a few inches. The average result is close to two barrels per grind. Drills are ground after each two barrels, regardless of condition, in order to save damage to the clearance angle. A feed rate of 1 in. per min. has proved satisfactory with some high-speed drills, thus affording a total drilling time of 36 min., while in other cases the feed has had to be cut down, and the drilling time increased to about one hour per barrel. Trouble with drills has arisen when barrel stock reached 320 Brinnell. Attempts to increase the feed rate with the first batch of carbide-tipped drills were not uniformly successful, although some barrels were drilled in approximately 20 min. with a 1⅛-in. feed. Eventually it may be possible to drill gun barrels in production with carbide-tipped tools in fifteen minutes or less. From the results already obtained with the hard cutting materials upon rough turning and rifling operations, AC Spark Plug feels certain that its efforts to pioneer the use of carbides on barrel drilling will be rewarded.

Three operations are customarily employed by the AC Spark Plug to ream the drilled machine-gun barrel. AC was the first to install Baush twelve-spindle vertical reaming machines, which are currently employed for the first two operations only. Installation of these machines has not speeded up the reaming cycle on the individual spindle, but floor space is saved,



Three broaches are employed to broach the bore and the rifling, according to the Illinois method. The round broach finishes the bore diameter. The first rifling broach, not shown, finishes the width of the grooves and cuts them approximately two-thirds deep. The second finishing broach has a splined pilot, as shown, and follows the path of the first rifling broach to cut the grooves to full depth but without affecting the width

handling is reduced and the operator is able to handle about twice the number of spindles possible with conventional equipment. Drilled barrels are brought to him by conveyor.

The gun barrel has been drilled to 0.489–0.001, and must be reamed to 0.5010–0.001 in. In the first ream on Baush equipment, the hole size is increased to 0.4943–0.001 in., and in the second ream to 0.498–0.002 in., the third reaming on conventional equipment is done to 0.5010–0.001 in.

In effect, the Baush machines consist of twelve independent motorized reaming spindles which are operated at conventional reaming speed and feed, using a standard push-type reamer threaded into a tube. The barrel is mounted in a carriage and pulled up and over the reamer by means of a chain passing over a sheave and connected to a hydraulic cylinder at the back. At the lower end, the barrel is positioned in a cone center, while the upper end rests in a V-block and is held by a swing clamp. At the top of the stroke, the spindle driving clutch is disengaged, the reamer stops, and the barrel is dropped down over the reamer to the unloading position. Reamer marks within the hole are of no importance because finish reaming will be done later with conventional equipment. The feed rate is set at 6 in. per min., but can be changed if desired.

Through considerable experience in application of carbide tools to the cutting of steel, the AC Spark Plug plant was convinced that inserts on rifling cutters would expedite production and attain satisfactory finish. Conventional rifling cutters were fitted with inserts and used in Pratt & Whitney two-spindle barrel rifling machines. It has been possible to boost the cutting speed of the machine up to the return speed, or from 20 to 60 ft. per min., and the quality of finish is excellent. As compared with high-speed steel rifling tools, carbide tools have boosted production from one to four barrels per hour and the number of barrels per grind from approximately one to twelve. Two effects are forecast through this development: (1) the conventional rifling equipment now installed will have a far greater output than originally contemplated and (2) plans to broach the rifling and eventually the finished bore diameter are now predicated upon the use of carbide broaches operating at 60 ft. per min., although high-speed steel broaches will be used until

satisfactory carbide broaches are developed. Rifling with carbide tools is still on an experimental basis.

The interest displayed by small-arms plants in broaching the bore and rifling springs from these factors: (1) one broaching machine has approximately twenty times the production capacity of conventional two-spindle rifling machines, to say nothing of finish-reaming machines displaced, (2) the cost of a broaching machine, a special sharpening machine and the inspection fixture—all of which are essential to a plant set-up—is approximately one-tenth that of the twenty rifling machines, (3) the amount of labor can be reduced by broaching, and (4) firing tests indicate that a target pattern made with a newly broached barrel is equivalent to and perhaps more uniform than the pattern made with a reamed and rifled barrel, and that after several thousand rounds have been fired, the pattern for the broached barrel is superior to a new barrel in respect to accuracy and uniformity. These benefits are believed to arise because all tool marks in the broached barrel are parallel to the helical flight of the bullet, and there are no crosswise scratches to load with particles from the projectile.

To broach the bore or rifling on Illinois equipment, the proper broach is inserted in the barrel, and the oil-retaining tube at the far right is slipped over the broach and is locked before the cutting oil is turned on. The oil flows in the direction of the cut, washing chips ahead of the broach teeth and into spaces between them

AC Spark Plug has installed an Illinois horizontal, single-spindle broaching machine that handles the bore and the rifling with three broaches used in sequence. A LaPointe multi-broach station-type machine has been ordered. Five broaches are passed through the barrel in sequence and mechanically retrieved, thus promising to speed production by avoiding manual broach handling. Five barrels are in process at one time and the sixth station on the drum is used for loading and unloading. Recent developments indicate that perhaps three broaches will handle the job.

One of the chief problems faced by mass-production gun plants such as AC Spark Plug is that of securing broaches at a cost that will make the adoption of rifle broaching feasible on an economic basis. It is estimated that broaches will produce from 50 to 100 barrels per grind, and with twenty grinds permissible, from 1,000 to 2,000 barrels can be secured during the life of the tool. Because of the necessary complexity of the broach, its first cost and its maintenance cost are high at present, despite its productivity. Expansion of the country's broach industry is considered essential by manufacturing engineers in order to accommodate new and heavy loads imposed upon it by mass-production small-arms plants.

Three slender broaches 87$\frac{1}{16}$ in. long with a root diameter of 0.3125 in. are required to broach the cal. 0.50 barrel, according to the original method devised by the Rock Island Arsenal in conjunction with the Illinois Tool Works and now being tried on an experimental basis by the AC Spark Plug Division. The broaches to be described show the general principle, but are undergoing detail refinement, especially to reduce the length.

The first broach finishes the bore as reamed on the second Baush machine. There are four groups of teeth. Section 1 has six splined roughing teeth ranging in diameter from 0.4970 to 0.4998 in. in 0.0007-in. increments. Section 2 consists of six round roughing teeth in the same size range, and operating to remove the eight lands left by the splined roughing teeth. Section 3 embraces five round semi-finishing teeth increasing in 0.0002-in. increments from 0.5001 to 0.5009 in. Section 4 has five round finishing teeth of 0.5010-in. diameter to finish the bore. This broach eliminates the conventional finish-reaming setup.

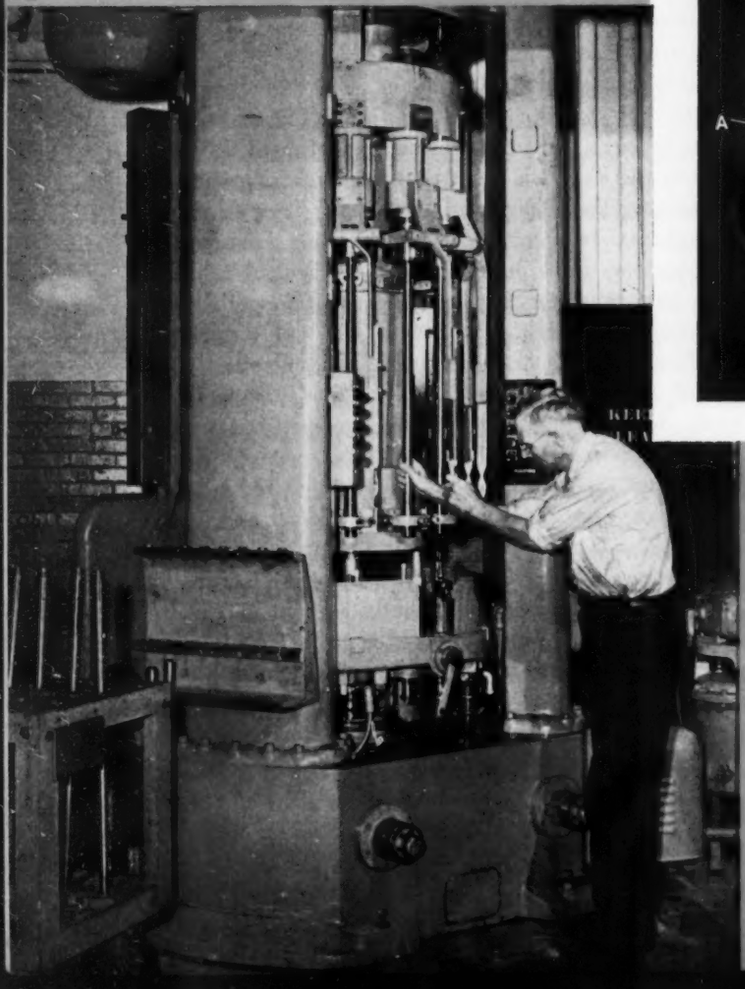
Rifling actually commences with the second broach. At the front end there is a round "diameter"pilot, but

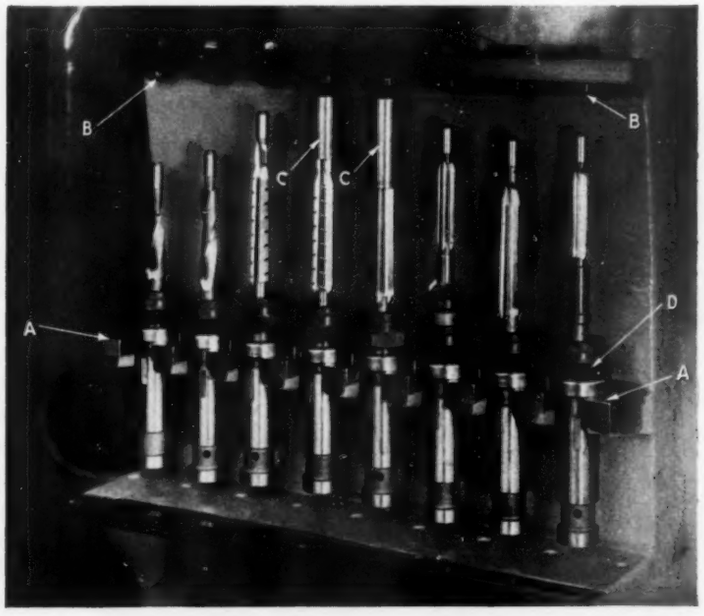
the tool cuts its own helical path. The tool is gripped in a ball-bearing pulling head and is thus free to follow the helical lead cut by the broach teeth. This broach has eight teeth in the roughing section, the teeth increasing in diameter from 0.5014 to 0.5070 in. in 0.0008-in. increments. Thus, the rifling grooves are roughed to a depth of 0.0030 in. by the roughing section. The four finishing teeth on this broach are all of the same diameter, 0.5078 in. Eight grooves are cut to a depth of 0.0034 in. (approximately two-thirds of final depth) and to a width of 0.139 in. This is a finishing broach in that the width of the groove is finished.

Broach No. 3 has a four-splined pilot that fits in the previously broached rifling grooves. Seven roughing teeth range in diameter from 0.5074 to 0.5104 in. in increments of 0.0005 in. In other words, the roughing teeth remove a chip two and one-half tenths thick. Four finishing teeth are all 0.5109 in. in diameter. Consequently, rifling grooves are cut 0.0049 in. deep in two broachings, whereas by conventional rifling methods, using a single cutter and taking a 0.0002-in. chip, nearly 200 indexings would be required.

Certain peculiarities should be noted in these broaches. The bore broach has oil holes drilled at an angle through the semi-finishing and finishing teeth so that high-pressure cutting oil can wash the chips in the direction of the cut. The early rifling tools, broaches Nos. 2 and 3, actually have two-part teeth; that is, a front and rear part. Each part has four opposed cutting edges. The splines on the rear part are 45 deg. from the centerlines of the splines on the front part. In other words, one part cuts four grooves; the other, the remaining four grooves. To shorten the two rifling broaches almost by half, the front and rear parts of each "tooth" will be combined, thereby broaching eight

Outstanding in showing the influence of automotive technique in obsoleting traditional methods of machine-gun manufacture is this ten-station Krueger chambering machine. Production is approximately six times as fast as hand-oporated chambering machines





Nine reamers, only eight of which are shown, are employed in the Krueger chambering machine. Tools are shown in the fixture which presets them to gage length. Surface *A* represents the datum plane of the machine. Buttons *B* represent the junction of the chamber with the bore. Tools are set to length by means of various gaging sleeves *C* and the micrometer adjustment nut *D*. Reamers follow designs employed by the Springfield Arsenal except that Nos. 1 and 2 divide up the roughing cut in the long taper

splines instead of four with each tooth. Behind each tooth there is an oil-grooved pilot that should have a diameter clearance of 0.0003 to 0.0005 in. to maintain the rifling grooves concentric with the bore. The face of the button probably should be straight to prevent picking up a "bug" and seizing.

The Illinois pull-broaching machine, in which these broaches are used, is fitted with a screw feed instead of an hydraulic feed to avoid chatter arising from broach flutter. The broach is inserted in a guide bushing at the breech end of the barrel, and an oil retaining tube with a seal is placed over the broach and tightened in position with a twist of the wrist. Then with the pull bar engaging the broach, the high-pressure cutting oil can be turned on and the feed engaged.

For high-speed steel broaches, such as currently available, the cutting speed is 20 ft. per min., but the machine is capable of 60 ft. per min., because of AC's anticipation that satisfactory cemented-carbide broaches can be developed. Effort to pull the broach through the barrel is in the order of 700 lb., which indicates that no trouble should be experienced with loosening cemented-carbide broach disks brazed to a steel bar. The chief problems with satisfactory carbide broaches will be: (1) to grind and stone the teeth to practically perfect uniformity in chip-taking action, and (2) to train a sufficient number of men in the art of broach maintenance for mass production.

Under present circumstances, barrels should be broached completed with three passes on Illinois equipment at the rate of fifteen to twenty barrels per hour, and on the LaPointe machine at the rate of 30 to 40 per hour. Whether broaching will displace finish reaming and rifling depends upon the economics of tool cost and tool maintenance. It now appears that broach cost will be reduced sharply and that further cost reductions can be effected when their manufacture is put on a production basis. Finish reaming requires fifteen minutes per barrel, while rifling takes one hour with a conventional tool and fifteen minutes with a carbide-tipped hook cutter. At best, these two operations require 30 min. per barrel, so it may be predicted that broaching will be done from ten to twenty times as fast as the displaced operations and probably faster when carbide broaches are developed.

Opening out the finished bore at the breech end of the barrel to form the complex-contoured chamber for the cartridge is considered one of the fine arts in the gun-making trade. Precision workmanship has been obtained only with aptitude and adequate training in operating hand-fed machines that use slip reamers interchangeably in a special tailstock or reamers held in an indexing turret. Production averages five to seven chambered barrels per hour. If operators depart from painstaking care, tool breakage and machine downtime become serious impediments to desired output.

Master mechanics and tool engineers in the auto industry have no appreciable background in the gun-making tradition, but are characteristically impatient with slow methods and soon take steps to find faster ones and especially to remove the variabilities of the human element from the operation. After purchasing a number of the up-to-date chambering machines such as used by arsenals, so as to insure adequate production on this operation in the months to come, L. H. Benson, master mechanic, AC Spark Plug Machine Gun Division, worked with H. R. Krueger, of H. R. Krueger & Company, upon the idea for a mass-production chambering machine. The result is the Krueger ten-station mass-production chambering machine, which keeps all chambering tools in use simultaneously and does not depend upon the operator's skill. Production at first will average 30 chambered barrels per hour, with the machine operating at slower than normal feed, and 40 barrels per hour when adequate experience has been obtained with the new method.

The fundamental concept of the Krueger machine envisages: (1) all tools preset to a common gaging level, or datum plane, (2) barrels chucked in such a manner that the breech ends shall be a specified distance above the gaging level, (3) each tool to be fed a definite distance into the barrel above at a feed rate most suitable for the particular chambering operation involved. Construction details have been worked out as follows:

The ten-station barrel carried indexes automatically around the central column at the specified point in the cycle. Each barrel is held at the upper, or muzzle end in a lever-operated collet chuck and caused to run true at the lower end in a steadyrest. Each of the steadyrest points is backed by springs to allow some float of the barrel to the reamer.

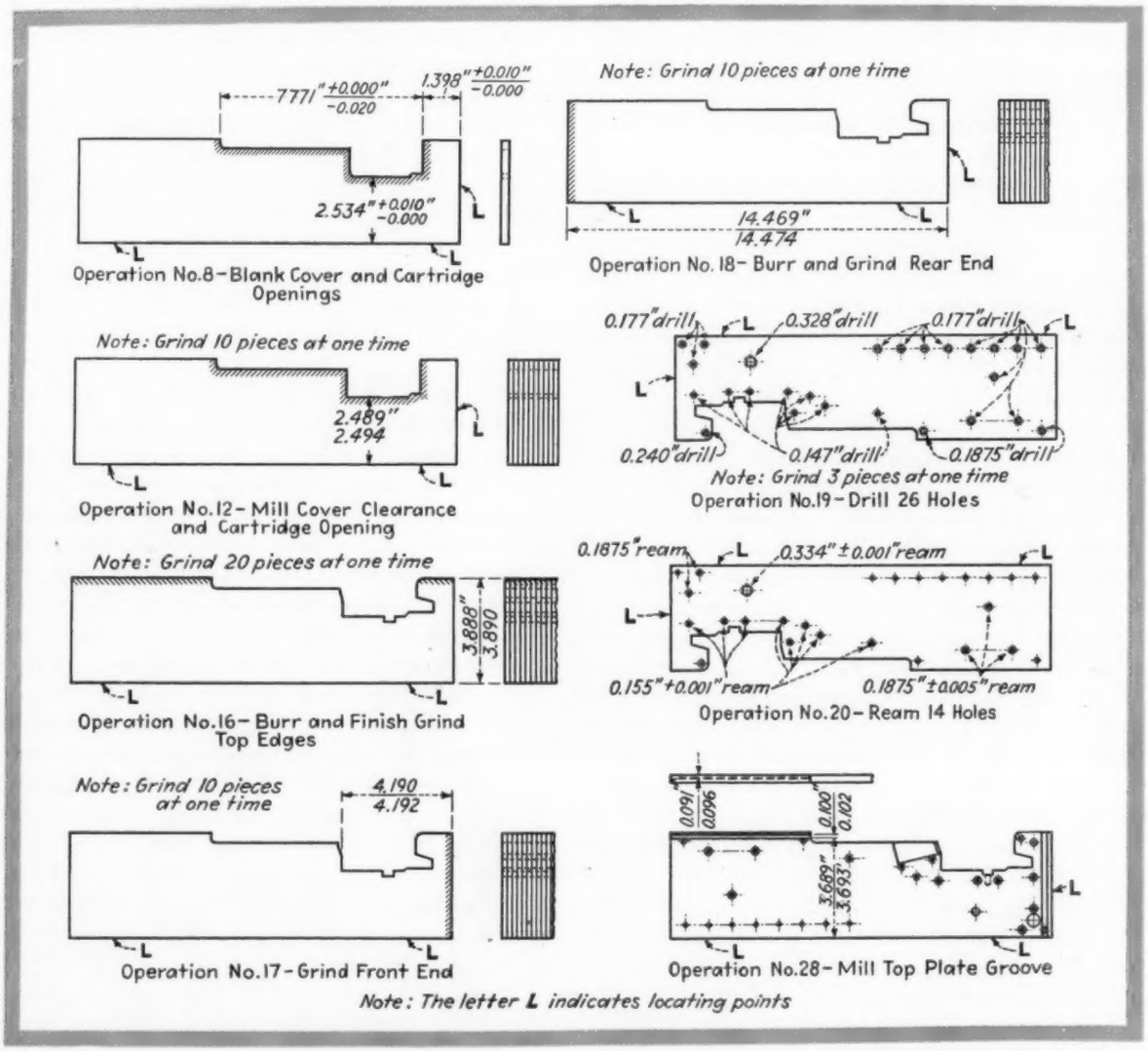
Below the indexing barrel carrier there is a tool carrier that can be automatically raised and lowered to engage or clear the tools with the barrels in the stations above. In the case of the cal. 0.50 set-up, this distance is established as 5 in. To proceed with chambering operations at the respective stations, the independently actuated tool quills are moved upward an additional distance by feed cams. A cam ring below the tool carrier is fitted with nine cams, each having a rise suitable for feeding the given tool. The cam ring oscillates through an arc of 36 deg. (one-tenth circle). On the forward stroke the tools are allowed to return to the original position.

Top faces of the tool quills are ground in a horizontal plane, which represents the gaging level. Tools are preset in a fixture affixed to the machine column. Each tool is locked in a toolholder, which has a micrometer nut and ground fine-series thread. Over the

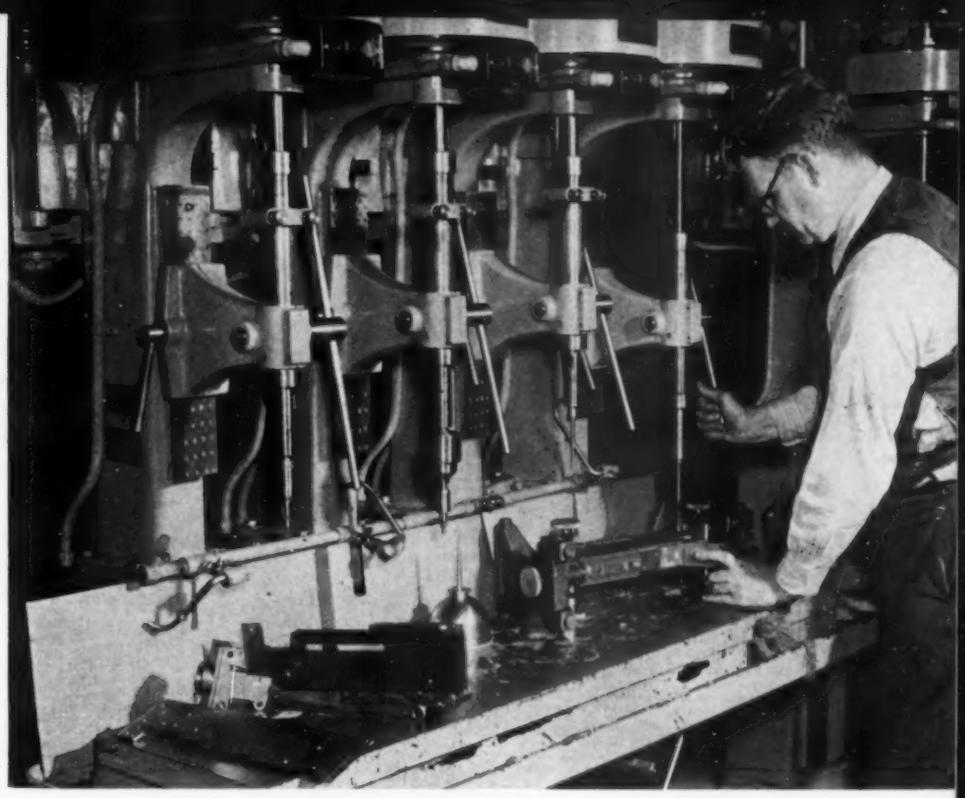
piloted end of the tool is slipped a gaging sleeve, which has a short internal taper corresponding to the reference taper on the end of the pilot. To adjust the tool height in reference to proper extension beyond the spindle quill, the above assembly is slipped between the gaging surface in the fixture and a hardened button. The micrometer nut is then adjusted until it seats upon the gaging surface of the fixture. Buttons in the fixture are equidistant from the gaging surface, tool heights being fixed by gaging sleeves.

To load the barrel properly, end-wise locating means are provided at the loading station No. 1 to position the breech end at a specified distance above the gaging level. At this station there is a loading pilot which has vertical travel by means of a crank. The breech end of the barrel is placed on this loadinig pilot, the crank turned and the muzzle end of the barrel entered in the collet chuck. The crank lifts the breech end a specified distance as dictated by a positive stop. After closing the collet chuck and the steadyrest, accurate positioning of the breech face of the barrel is checked with a swing-type dial-indicator fixture. If correct, the index button is pressed and the cycle proceeds automatically. Each barrel is rotated at the proper cutting speed for chambering operation.

Because of the production characteristics of the Krueger machine, consideration is being given to development of Carboloy tools in order to minimize off-gage chambers and down time for tool changes. One of the features of the machine that will assist in preventing rejected work is the overload device on each spindle. If a tool catches in the work or cutting effort exceeds suitable limits, the overload device trips a switch, which causes the tool carrier to return to the



Principal operations in manufacturing a left-hand side plate for a Browning cal. 0.30 machine gun. Prior to drilling and milling, the piece is ground on all six sides to achieve accurate locating surfaces



Building up a Machine Gun Case—Forty operations of the 1,800 required to produce a cal. 0.30 Browning machine gun are consumed in assembling the several components of the gun case. Here an operator has assembled the right- and left-hand side plates, the top plate, the bottom plate and the trunnion block (all parts of the case) upon a harness, or box fixture, for line-reaming and countersinking the rivet holes in four operations

down position and the machine to stop. A red light flashes on a panel to indicate which tool, or chambering operation, is giving trouble.

From the World War until operations commenced in April at the new machine gun plant of the Saginaw Steering Gear Division of General Motors, the cal. 0.30 Browning had not been made in production. Without an up-to-date pattern to follow, the Division was forced to tool up from scratch, relying upon its production "know how" to equip and tool its plant for this gun in a very few months.

There are 189 individual parts in the cal. 0.30 Browning, of which 153 are made at Saginaw by application of 1,800 distinct operations. Some of these parts may need only a dozen or so operations, but more complex items require considerably more, the bolt for example including 83 hand and machine stages in its manufacture. Machine gun work is largely a matter of "worrying the metal away." Parts are comparatively small, most cuts are light, and milling in various forms plays a predominate part in the manufacturing processes. So far as possible, skill is transferred from the man to a modern machine fitted with a highly accurate fixture because untrained labor must be recruited and taught to handle one simple operation. The tooling methods obviously seek to attain accuracy at initial operations and maintain that accuracy throughout the entire manufacturing process in order to avoid a high percentage of scrap.

The initial contract called for the production of a large number of guns per day plus spare parts (the latter require expenditure of an equal amount of labor). So far as practicable complete production lines are set up for each component, although to provide permanent setups for every machining operation would entail double the number of machines, many of which would be idle for part of the time. For this reason 1,300 machines were specified, of which 1,165 are new and 135 were obtained from storage at the Rock Island Arsenal, then rebuilt and motorized. The plant was approximately one-half equipped on the first of May, gun assemblies were accelerating since the first gun was made in April, ten months ahead of schedule, and approximately 800 workers were distributed over three shifts. By February, 1942, in excess of 4,000 workers will have been hired and trained.

The tooling problem involved production of 8,000 tool drawings and design or specification of 6,000 initial tools. This process will consume 62,000 man hours of engineering labor, while the building of the tools, jigs and fixtures will cause expenditure of 250,000 man hours of labor in vendor's plants.

In setting up operation schedules for machine-gun parts, Saginaw's engineers drew freely from the methods of automotive-parts manufacture. It is inescapable, of course, that many operations must be performed singly, but even here type and design of fixture bespeak the automotive tool engineer in respect to incorporation of accurate locating means, "fool-proof" loading and quick-acting positive clamps. Parts are often doubled up in fixtures, or the fixture built so that it will accommodate a right- or a left-hand piece, to decrease machine set-ups. Occasionally, the high-production note is seen, especially in multiple-spindle drilling and the use of a chucking machine instead of a battery of turret lathes.

Hundred of machine set-ups in the Saginaw plant are much alike, the principle of fixture and tool being repeated over and over and merely adapted to the particular operation. Principal gun components require

too many operations for detailed comment, but skeletonized operation sequences and discussion of equipment and fixtures used will give an idea of the manner in which an automotive-parts plant has embarked upon machine-gun manufacture. Examples chosen are the side plate for the gun body, the trunnion block and the bolt. Some set-ups for the cal. 0.50 parts produced by the AC Spark Plug Division are included to show the different approach to the tooling problem because of variations in part design or production technique.

Production methods for side plates of the gun body are indicative of the tooling philosophy employed by the Saginaw Steering Gear Division for many machined parts. In this case, the raw material happens to be strip stock rolled to close tolerances for thickness and flatness and with round edges to save mill time and cost. Before the final stages of drilling and especially the milling of four accurately located grooves, it is essential to grind all six surfaces.

After sawing the strip to rough lengths, square edges and ends are obtained by milling in gang set-ups. In slab milling the edges and straddle milling the ends, an allowance is made for finish grinding. One side of the blank is also surface ground to present a scale-free surface to the punch when blanking out the cover clearance and cartridge opening. To rough mill this contour would prove a time-consuming operation; hence it is blanked, leaving enough stock for finish milling. The press is set up with two dies, one for a left-hand and the other for a right-hand blank, since the contours differ.

To overcome distortion arising from the blanking operation, the unfinished side of the piece and the bottom edge (opposite the blanked edge) are surface ground. With two parallel sides and a square bottom edge on the piece, it is now possible to stack the side plates ten at once in a machine vise for finish milling the cover clearance and cartridge opening, with the exception of a bottom slot and a bullet clearance contour which are handled in two additional milling set-ups. Gang cutters were originally employed for finish milling the main contour, but have since given way to a form milling cutter.

At this stage, the two sides and the bottom edge of the piece have been finish ground. It remains to grind the other three sides prior to drilling numerous holes and milling four grooves. The top edge is ground first to establish the finished width of the piece within a tolerance of 0.002 in. Twenty pieces are stacked in a vise, being located from the bottom ground edge. This operation is performed on a No. 34 Abrasive vertical-spindle surface grinder. The ends are ground in two further set-ups on an 18-in. Abrasive face grinder. Separate fixtures are employed for right- and left-hand side plates. To grind the front end, location is taken from the finished bottom edge and from a face in the milled contour. To grind the rear end of the side plate, location is taken from the newly ground front end and the bottom edge. The last locating points are employed in subsequent operations.

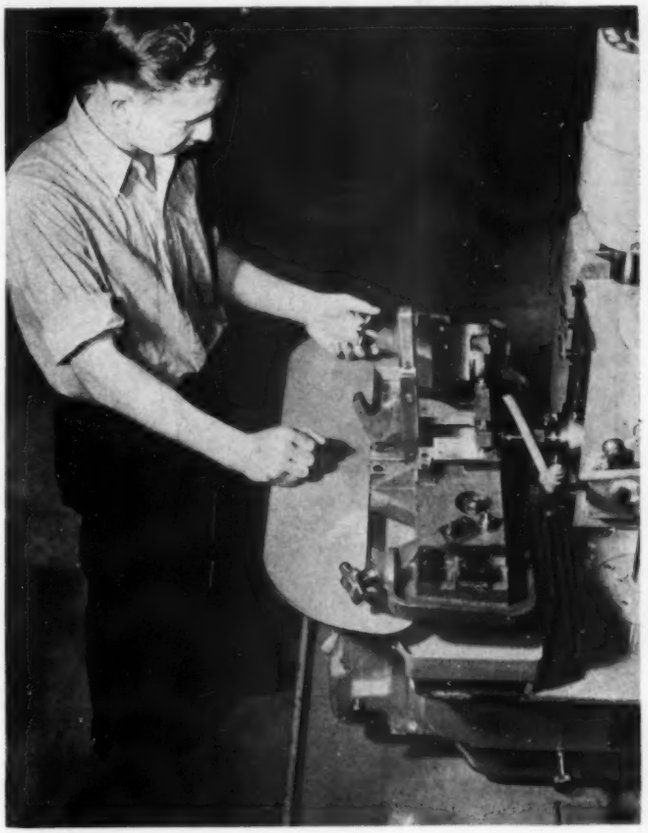
The next major operation involves drilling practically all of the holes in the side plate at once on a Natco multiple-spindle machine instead of numerous single spindle set-ups. Spacing of the 26 holes drilled in this operation does not permit handling all holes in one operation. To save set-up time and a second machine, a two-position fixture is employed, three pieces being drilled at once. In the rear position twelve holes are drilled, after which the fixture is slid on rails to the front position for drilling the remaining fourteen holes. In either position the fixture registers against adjustable stops. Guide bushings in the bushing plate register with guide pins in the fixture, when the head is brought down. The spindle head on the machine is adjustable to accommodate changes in hole spacing if desired at any time.

While an essentially mass-production set-up was chosen for drilling the side plates, the following operation of reaming fourteen holes is carried out on a four-spindle gang-type machine. The side plate is loaded into loose box-type fixtures, one for each of the multiple-spindle reaming heads. In this case it is cheaper to use more labor, whereas in drilling the number of holes and the length of the operation suggested a more expensive machine and fixture.

The reason for grinding the part on all six sides to tolerances of 0.002 in. becomes apparent when the side plate progresses to the four grooving operations. The most important of these happens to be that of milling a through slot parallel to the front edge. Correct depth and width of the slot and distance from the slot to the front edge of the side plate are important because this groove takes the impact of the recoil mechanism through the trunnion block. Right- and left-hand fixtures are set up on a Cincinnati knee-type machine so that the trunnion-block groove can be milled in right- and left-hand pieces at the same time. The other three grooves—top plate groove, back plate groove and the lock-frame guide-pin groove—are milled in three succeeding set-ups on Cincinnati rise-and-fall milling machines. In each case one fixture is provided and one piece is milled at a time because the machine is fitted with cams for milling one groove only. The fixture is however fitted with duplex locating elements, so as to accommodate a piece of either hand. Foolproof loading is attained by pins that prevent improper location of a piece of a particular hand.

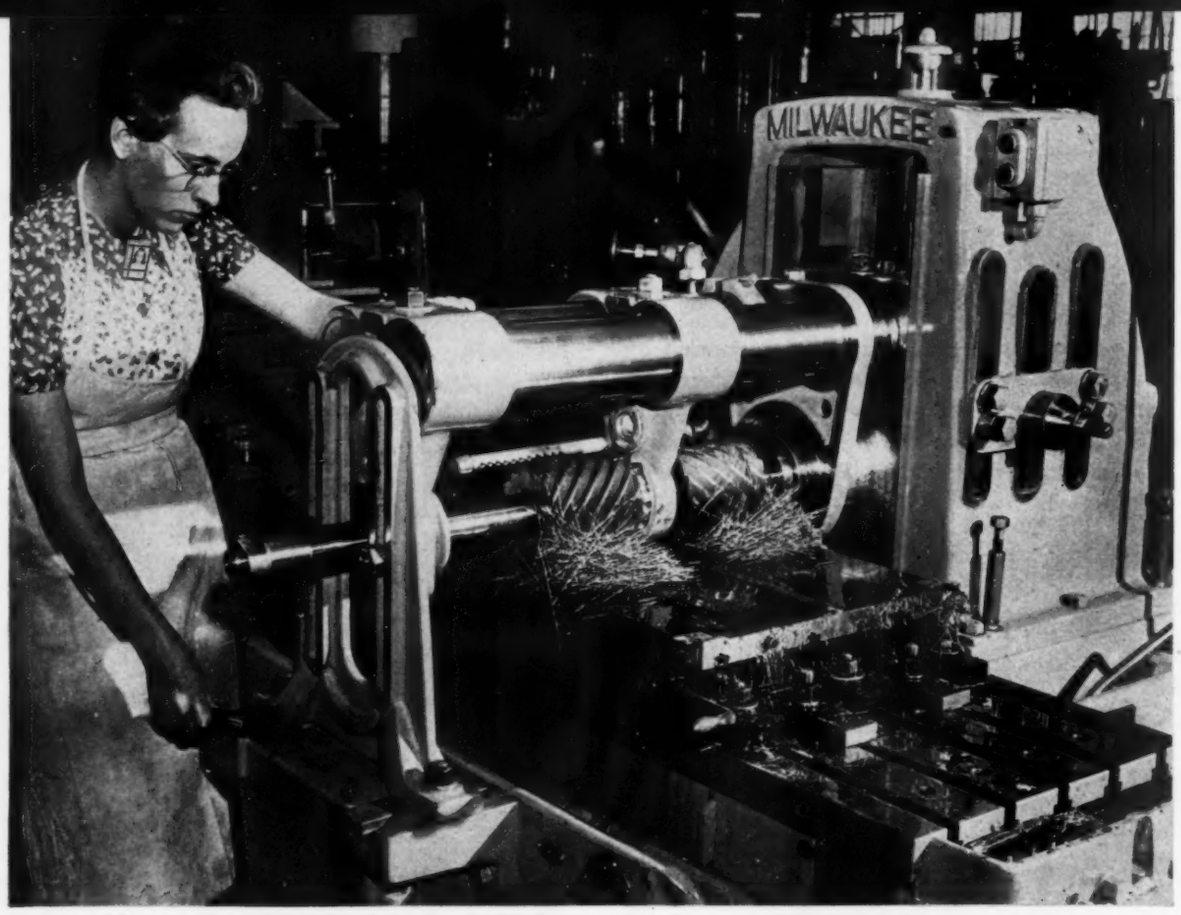
Further evidence of the automotive influence upon machine gun tooling is shown by the equipment chosen

Three of the grooves in the sideplate are blind at the ends, hence are most conveniently produced on Cincinnati rise-and-fall millers. In this set-up, the double-position fixture accommodates a left or right-hand side plate



Blanking the cover clearance and the cartridge opening saves a tedious milling operation, leaves only a few thousandths stock for finishing milling. Dies are placed in a Bliss No. 306½ crank press for blanking one right- and one left-hand plate per stroke

To save numerous set-ups, 26 holes are drilled in side plates (three at once) using a Natco machine with multiple-spindle head. Close center distances compels drilling the holes in a two-position fixture, which slides on rails. At the first, or rear, position fourteen holes are produced, and the remaining twelve at the front fixture position



One of the heaviest milling cuts in machine gun work is that of slab milling two cal. 0.50 side plates at once at the AC Spark Plug Division. This operation is required to reduce the stock thickness over the majority of the side plate's area, leaving a thicker section at one end for cutting the trunnion-block groove. Magnetic chucks firmly hold two side plates while 13 cu.in. of metal is removed from each plate by climb milling. AC plans to eliminate slab milling by upsetting one end of thinner side plate material

for drilling the cal. 0.30 and cal. 0.50 trunnion blocks. These parts vary greatly in size and the drilling problems are totally unlike.

To avoid the long time cycle of drilling through $1\frac{9}{16}$ in. of metal, the Saginaw Steering Gear Division has tooled up to drill the cal. 0.30 trunnion block half way through from one side, reverse the part in a second fixture for drilling the remainder of the hole depth from the opposite side and ream at a third station. The set-up involves a three-spindle Allen drill press fitted with power feed and automatic return mechanisms on each spindle. Each station involves the use of a multiple-spindle U. S. drillhead, which is fitted with guide bars to the bushing plate, and the bushing plate is also guided upon pins in the fixture. With this set-up, one operator handles drilling and reaming the two rivet holes and one mount hole in the part, and spends the largest percentage of his time in actually loading and unloading parts rather than waiting for the drills to break through.

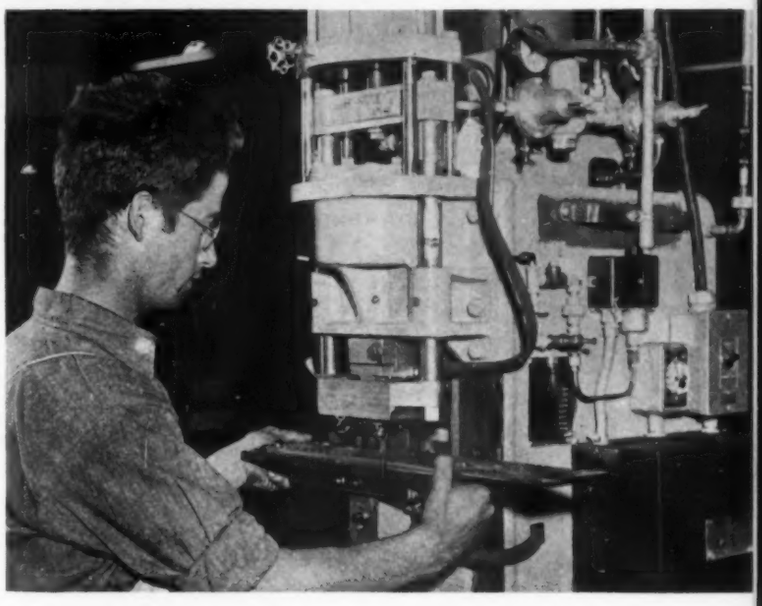
A totally different problem arises in drilling the rivet holes in the cal. 0.50 trunnion block processed by the AC Spark Plug Division. In this case the part happens to be larger, but the drilling time is akin to that required for the right- and left-hand side plates because the actual depth of metal to be penetrated does not vary too much. The reason for this circumstance is apparent from the nature of the cal. 0.50 trunnion block, which has the sides relieved so that drilling is done through flanges rather than a couple of inches of solid metal.

Since it is desirable to drill rivet holes in all three parts in the same set-up, so as to obtain 100 per cent interchangeability and alignment upon assembly, an essentially high-production machine was chosen. A Natco "Hole-steel" drill with 50 spindles in the fixed-center gear-driven head is arranged actually to drill 108 holes of 0.187 in. diameter because of fixture and spindle layout. There are 41 rivet holes in the right-hand side plate, 37 in the left-hand side plate and 15 drilled through each flange in the trunnion block (flanges are drilled from opposite sides). Close cen-

ter distances forbid drilling all holes in any part at one station. Hence the machine is provided with an automatically indexing rotary table having four fixtures—one for a left-hand side plate, another for a right-hand side plate and the remaining two for loading the trunnion block from the top and bottom respectively.

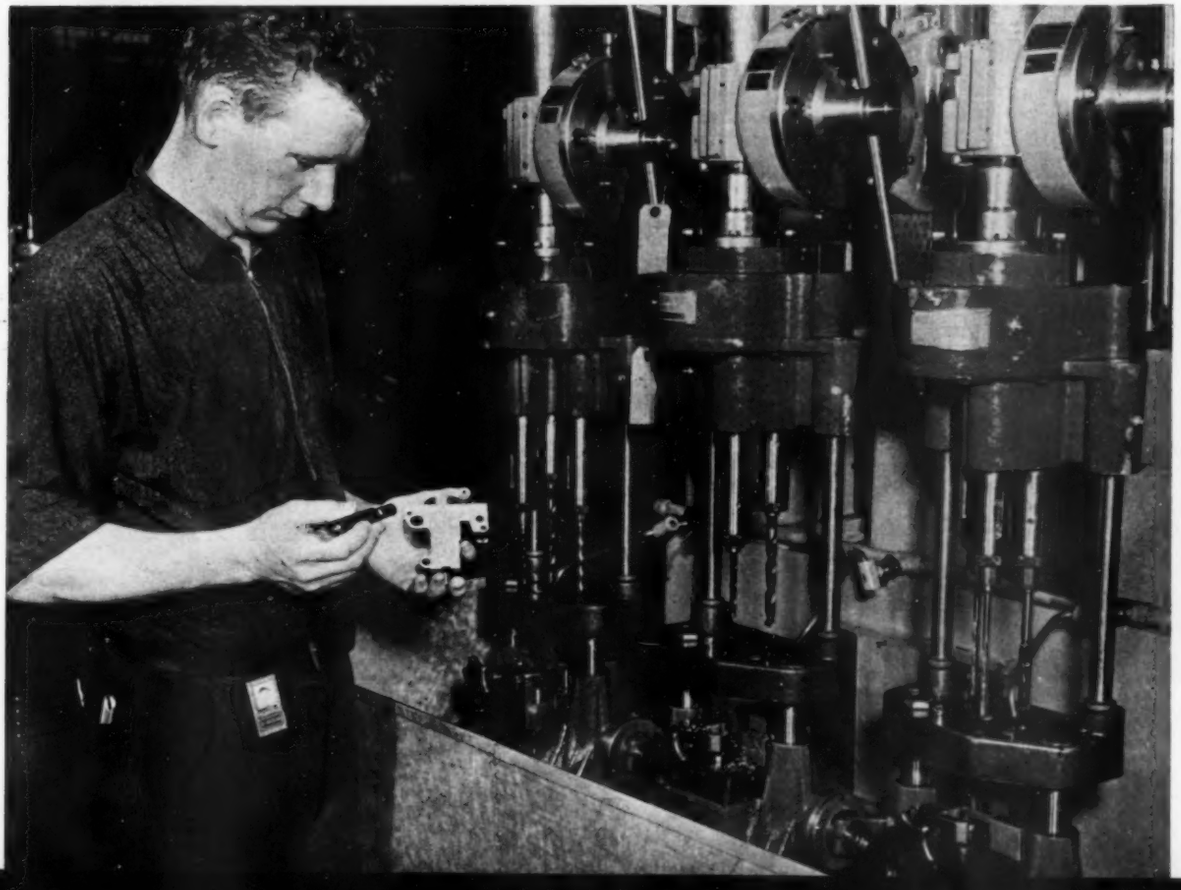
Only one part is processed at a time on the machine. In a side plate, for example, part of the holes will be drilled at the first station, more at the second station and the remainder at the third position, the fourth station being the unloading position. It was a nice problem to lay out the spindles and the fixtures (each of which takes part location differently) so that the drills register properly at any of the three working positions. Output is 45 right- or left-hand side plates per hour; or 15 trunnion blocks, which must be run through the machine twice. Obviously the machine will not be operated continuously, but its labor and equipment-saving characteristics as compared to single-spindle set-ups more than justify the high original cost.

The bolt is the most intricate part of the Browning machine gun, and its proper functioning depends upon adherence to rigid manufacturing specifications. The cal. 0.30 weapon employs a much smaller bolt than does the cal. 0.50, and the other chief difference is that the former has one belt-feed cam slot, whereas the latter has two slots crossing in an X-shaped pat-



Forge welding has displaced cold riveting at AC Spark Plug Division for making gun-case assemblies. Here an operator is electrically riveting a cam to a side plate. The cam is first positioned on the side plate by means of a jig and the rivet is inserted. Upon transfer to the National welder, the hold-down cylinder grips the parts tightly together. Advancing under a controllable time cycle, a second cylinder causes the electrode to contact the rivet

Because of the long drilling cycle, Saginaw Steering Gear chose to drill three holes half way through at each of the first two stations and ream at the third, instead of using separate low-production set-ups



tern. In other words, the infantry weapon can be fed ammunition from one side, whereas the aircraft gun must be operable from either side.

Eighty-three operations have been laid out by the Saginaw Steering Gear Division for production of the bolt for the cal. 0.30 gun. An accompanying skeletonized series of work-picture drawings (each operator gets a work picture for the job done at his machine) indicates that scores of operations involve milling a little here or a little there. Accurate locating surfaces are absolutely essential, and as with side plates the part is ground all over. In the case of the bolt, however, the four sides and the two ends are completely ground much earlier in the production process.

For form milling operations, arsenals have used profile ground cutters. These must be sharpened on the profile, a circumstance that compels the use of a cam and special profile grinder. Saginaw Steering Gear Division discovered that cutter manufacturers could not handle the volume of work involved in supplying initial tools or replacements and that delivery time of special profile grinders would prevent the plant from getting under way as planned. So it was decided to use the eccentric-form relief type of profile cutter wherever possible. These require grinding on the front face only of the teeth and can be sharpened repeatedly. Tooth spacing is coarser than in the profile-form ground type, but good finish is being secured.

Some profiles cannot be machined with form cutters, hence numerous operations involve the use of hand-operated profile millers, in which the operator guides the cutter manually while keeping a tracer spindle in contact with a form. One of the most interesting of these is Operation 60 on the cal. 0.50 bolt produced by the AC Spark Plug Division. A 30-deg. angle must be profiled on the cartridge starting face of the bolt. The job involves milling a tapered face along a roughly semi-circular path and blending the ends of the cut with the points on two guide rails on the bolt as well as blending the tapered face with the "floor." From the nature of the job, two cutters must be employed. Hence the machine is supplied with two cutter spindles. A taper cutter in the right-hand spindle roughs the floor and the central sector of the 30-deg. tapered face. To mill the corners and

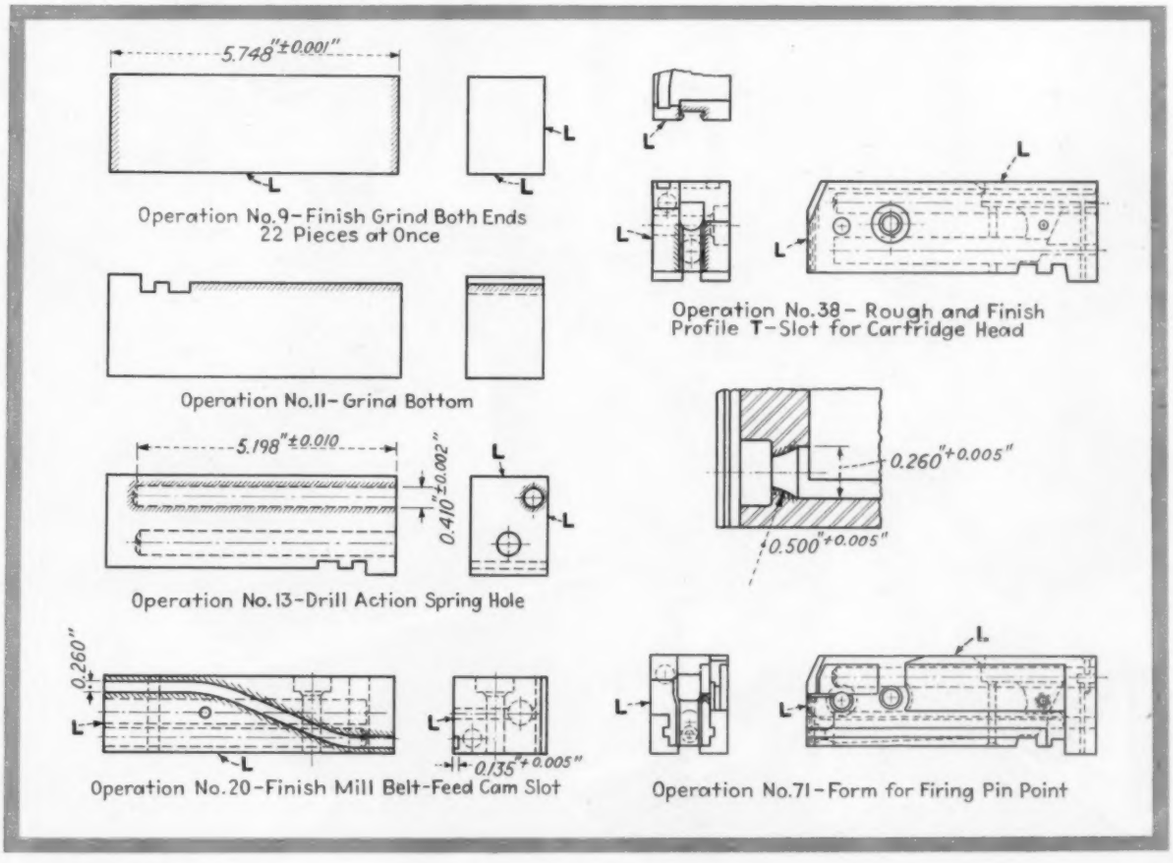
Fifty spindles properly located with respect to four fixtures permit this rotary-table Natco to handle the drilling of 108 rivet holes in the two side plates and the trunnion block of the cal. 0.50 gun. The three parts are processed separately by AC Spark Plug but are 100 percent interchangeable

blend the taper with the "floor," a flat cutter in the left-hand spindle is employed. The spindle head in this case is caused to rise and fall, as determined by the tracer bearing against the form plate. Complex hand-profiling jobs of this type require exceptionally qualified operators.

Of the several score parts required in a machine gun, a large number have very sharp edges and light burrs after machining. To round the corners smoothly and uniformly is a production problem of the first magnitude because many of the parts have a number of intricate surfaces which are not readily accessible, while other pieces are small and difficult to hold. Filing methods would be unsatisfactory on two counts: (1) the excessive labor burden of handling mass-production quantities, and (2) difficulty in meeting part specifications for degree of corner rounding and finish. Fortunately the AC Spark Plug Division discovered an idea at the Springfield Arsenal for a machine method of doing the work and has had the process—tumbling—under continuous development for a number of months. Tumbled parts usually have

A home-made device saves time at AC Spark Plug in countersinking rivet holes. A foot plate containing a gear drive reaches between the flanges of the cal. 0.50 trunnion block to countersink the inner end of the holes, thereby saving the tedious work of using a loose cutter slipped over a spindle reaching through the opposite hole

Eighty-three operations have been laid out by Saginaw for production of the bolt for the cal. 0.30 Browning machine gun



Two similar set-ups are employed at Saginaw for rough and finish milling the single belt-feed cam track in the cal. 0.30 bolt. Constant downward hydraulic pressure on the floating cutter head keeps the tracer *A* in constant engagement with a cam plate *B* embodied in the fixture. Conventional movement of the table causes the cutter spindle to move up or down as the cam moves past the tracer

To hand profile the cartridge starting face on the cal. 0.50 bolt, AC Spark Plug Division has fitted a profiling machine with two spindles, in order to accommodate tapered and flat cutters respectively in the same set-up. The left-hand finishing spindle has a rise and fall movement obtained by the tracer riding on a tapered cam

a dull-gray matte finish, and the corners can be rounded or kept square as desired.

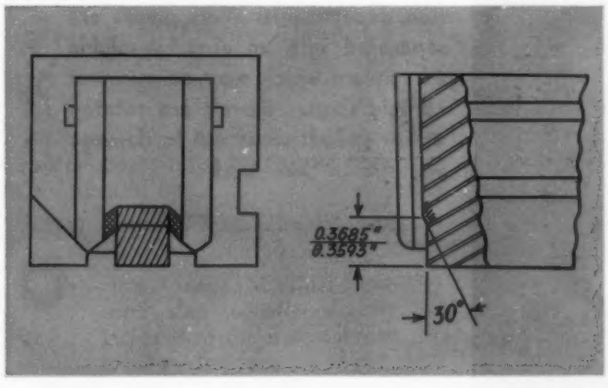
Tumbling for corner rounding and burr removal is distinctly different from burnishing. The principle is to separate the work pieces with an abrasive-soluble oil mixture which may or may not contain slugs, and to rotate the charge at low barrel speeds so that the work pieces do not fall against and damage one another. This idea applies only to parts which are not bulky or do not have considerable mass. There are some machine gun parts which are not suitable for free action in a tumbling barrel and hence must be mounted on fixtures within a special barrel, the abrasive mixture sliding over the fixture-held pieces as the barrel rotates.

Several precautions are taken to prevent the parts from damaging one another within the tumbling barrel. In the first place, the charge is never more than one-half the barrel capacity and frequently much less. Second, barrel speeds are from 25 to 35 r.p.m. As a net result, the parts slide over one another rather than tossing about. Third, barrels are fitted with a ½-in. thick Neoprene lining to prevent the parts from sliding against or bumping the metal interior of the barrel.

Only sufficient soluble oil is added to the charge to wet the parts, the abrasive, and the slugs if used. In other words, a liquid mixture is not desirable because it would prevent holding the abrasive and slugs in suspension at the low rotative speeds employed. Thus, when operating bench-type Mercil tumbling barrels with a 26-in. bottle diameter, the amount of soluble oil in the charge may run between ¼ to ½ pt., whereas in the larger Baird No. 2B sheet-steel bottle tumbling barrels from 3 to 4 qt. of oil may be used.

Three types of abrasives are employed: (1) silica wash, (2) No. 8 semi-silica flour, and (3) banding sand. The last is used only for certain tumbling operations in Baird three-compartment horizontal tumbling barrels. Quantities of abrasive customarily used in bench-type barrels vary from 3 to 6 oz., while 3 to 4 lb. may be employed in the Model 2B machines.

Slugs are not always required. Their use depends upon the permissible degree of corner rounding, the type of burr, and the prospect of damage to the piece by a peening action. All slugs are dead soft. Balls from ⅛ to $\frac{5}{16}$ in. in diameter, ¼ in. balcones or stamping waste can be used. Selection of the ball size is important, because balls will pack in holes of similar diameter. Slugs are not commonly used in the bench-type barrels, but cases arise when it is necessary to use slugs with small quantities of work or small



Operation 60 on cal. 0.50 bolt—profile cartridge starting face. The single cross-hatched area indicates the "floor" and part of the tapered cartridge starting face, which are hand profiled with one spindle. Double cross-hatched corners are milled and blended with adjacent rails and the floor finished with the second spindle

Right- and left-hand guideways on the cal. 0.50 bolt are ground with an Ex-Cell-O high-speed grinding attachment. Six surfaces in each guideway must be ground to a tolerance of 0.0017 in. and an obstruction prevents the use of a large wheel. Hence, a small wheel operating at high speed not only gets to the required surfaces but saves time

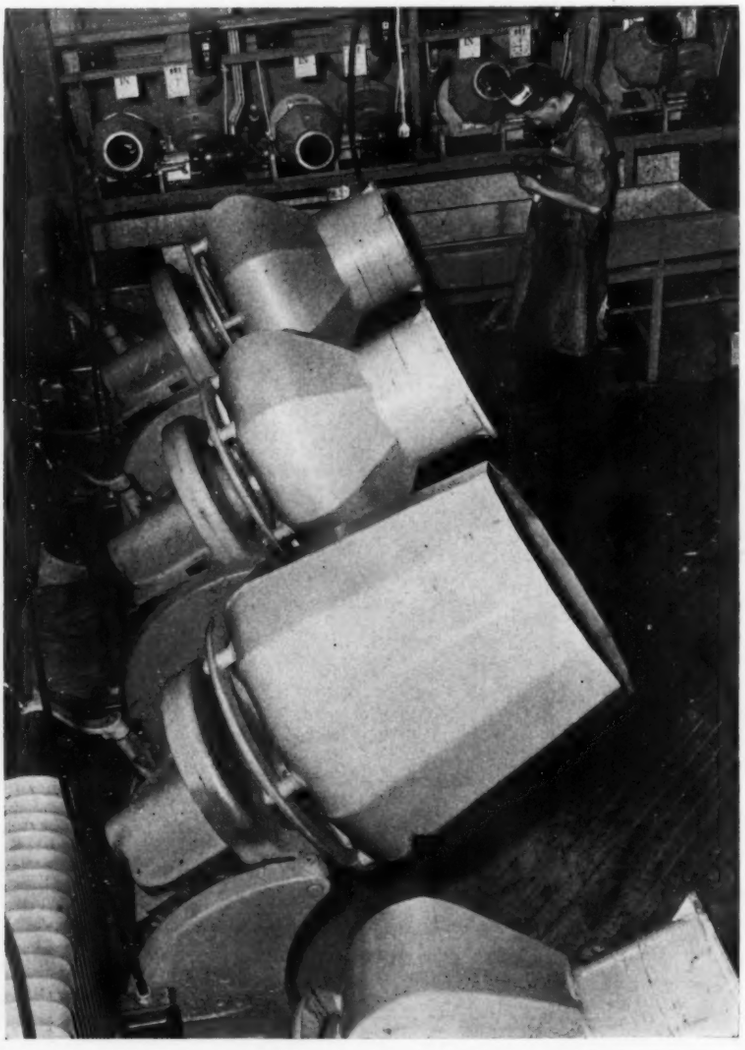
parts in order to make up a mass of sufficient weight for proper tumbling. Balls or balcones in weights of approximately 100 lb. are supplied to charges tumbled in the Model 2B Baird machines.

Tumbling time varies with the part, the permissible corner rounding action, the type of burr and whether or not the piece has been hardened. From 3 to 6 hr. is customary.

Most tumbling is done at the completion of machining operations. A growing application is the removal of light grinding burrs on blanks prior to machining to save the time an operator would spend in hand filing such burrs before loading into machine fixtures. Heat-treat scale is removed from hardened parts by the same process. In both applications, tumbling requires less time than corner rounding and removal of burrs from machined parts by the usual hand methods.

Some parts are not tumbled until after hardening because excessive peening action has been found to occur or the corners are rubbed off too much. Longer time is required to tumble hardened work but the load size can be increased because the damage from impingement is lessened.

AC Spark Plug Division is continually expanding the uses of the tumbling process. It should be understood, however, that the new method is not employed for removing heavy burrs thrown up at intermediate machining stages. Burrs other than of the light variety would be bent over onto the machined surfaces by the tumbling process. While heavy burrs could be cut away in the barrel, extra long tumbling cycles would be required and excessive dimensional changes would occur in the part. Heavy burrs are broken off at intermediate machining stages by the operators, in order to load the piece properly in the next machine fixture. Avoidance of heavy burrs at intermediate stages is a subject in itself.



A battery of tumbling barrels at a centralized location removes sharp corners and burrs from machine gun parts coming from several production departments. Work pieces are separated with an abrasive-soluble oil mixture which may or may not contain slugs. Barrels are rotated at low speeds so as not to damage the work

Reamers—Terminology and Definitions—I

SPONSORED JOINTLY by the Society of Automotive Engineers, the National Machine Tool Builders' Association, and the American Society of Mechanical Engineers, the new American Standard for Reamers (B5.14—1941) was approved by the American Standards Association on June 2, 1941. The following nomenclature is a part of that standard:

1. REAMER. A tool used for enlarging or finishing to size a hole previously formed.

2. LENGTHS. All measured parallel to the axis.

(a) *Overall Length.* The extreme length of the complete tool from end to end, but not including expansion screws.

(b) *Flute Length.* The cutting length of the flutes.

(c) *Shank Length.* The length from the end of the shank to the recess or to the flutes.

(d) *Recess Length.* The length of the section between the shank and the flutes.

3. SIZE. The diameter measured across two margins, at the cutting edge, on a diametral line.

(a) *Nominal Size.* The designed size.

(b) *Actual Size.* The actual measured size, usually slightly larger than the nominal size to allow for wear.

4. CHAMFER. The conical shaped portion at the front or entering end of the reamer.

(a) *Chamfer Length.* Distance measured parallel to the axis from the greatest to the smallest diameter of the chamfer.

(b) *Chamfer Angle.* The angle between the axis and a continuation of the cutting edge of the chamfer.

(c) *Chamfer Relief Angle.* The angle between a plane perpendicular to the axis and the intersection of the chamfer with the margin.

(d) *Chamfer Relief.* The relief put on the chamfer cutting edge to allow the reamer to cut.

5. LAND. The periphery of that portion of the flute length which is not cut away by the flutes.

(a) *Land Width.* The distance in a diametral plane between the cutting edge and the heel.

(b) *Cutting Edge.* The leading edge of the land.

(c) *Heel.* The following edge of the land.

(d) *Core Diameter.* The diameter of the largest cylinder which would not project into the flutes.

(e) *Relief.* The portion of the land ground away to enable the reamer to cut.

(f) *Relief Angle.* The angle between the relief and a tangent to the outside diameter circle at the beginning of the relief.

(g) *Margin.* The cylindrical part of the land adjacent to the cutting edge.

(h) *Rake Angle.* The angle formed between the cutting face and radial line drawn to the cutting edge.

6. FLUTE. That portion of the reamer which is cut away between the lands. Flutes may be either straight or helical. A reamer may have one or more flutes.

(a) *Straight Flutes.* The grooves and lands are parallel to the axis.

(b) *Helical Flutes.* (Sometimes called *Spiral*). The grooves and lands form a helical path around the axis.

(c) *Helix Angle.* The angle made by the leading edge of the land with the axis of the reamer.

7. SHANK. That portion between the back end of the flutes and the back end of the reamer exclusive of any recess or guide.

(a) *Straight Shank.* A cylindrical shank.

(b) *Squared Shank.* A shank having a square milled on the back end.

(c) *Taper Shank.* The back end of the shank is ground to fit a taper socket.

(d) *Tang.* A flattened portion on the end of the shank designed to fit the keyslot in the socket to assist in driving the reamer.

8. STARTING TAPER. The slight taper on the front end to facilitate the reamer entering the hole.

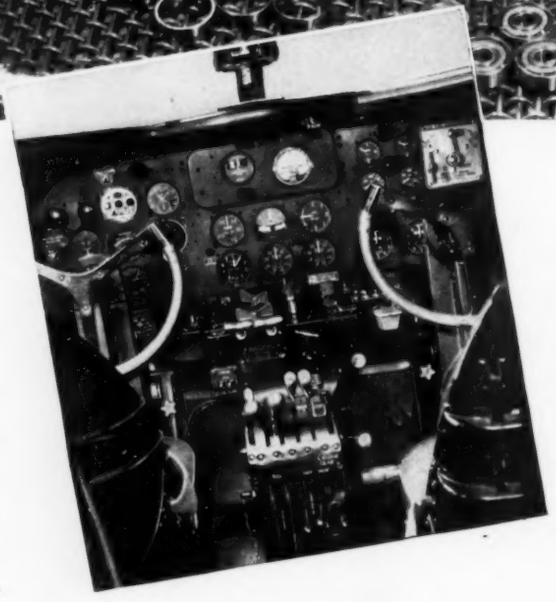
9. PILOT. A cylinder on the entering end of the reamer to keep the reamer in proper alignment.

10. GUIDE. A cylinder following the flutes of a reamer to keep the reamer in proper alignment.

11. RECESS. (Sometimes called *Neck.*) That portion or portions of the reamer adjacent to the flutes which has the diameter reduced in order to facilitate machining the flutes and grinding the land.

PRECISION BEARINGS DON'T LIKE

"The Skin You Love to Touch"!



● No matter how immaculately kept, bare fingers leave tiny spots of moisture that cause rust. For New Departure precision ball bearings going in ever-increasing quantities into the instruments, magnetos and controls of America's Aircraft, exquisite care is observed even to the final packing. From kid gloves that do not transmit moisture, to special lint-free costumes, every precaution is taken to assure that the nation's planes now building shall receive the best that American Craftsmen can produce.

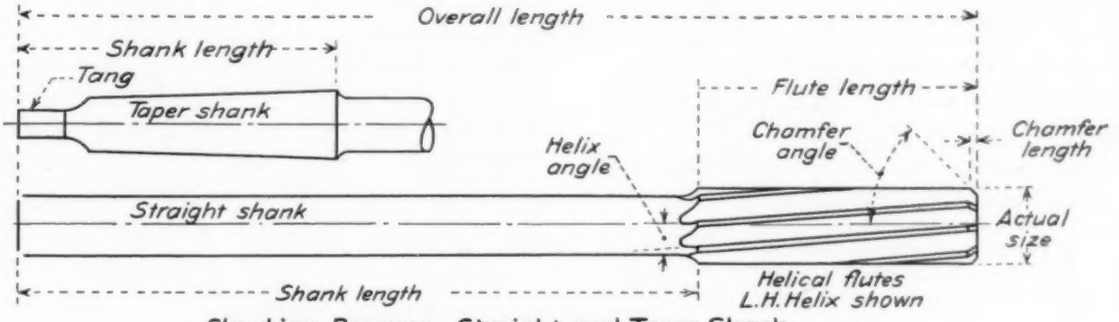
At left, instruments on control panel of Boeing Twin Engine Transport

3023

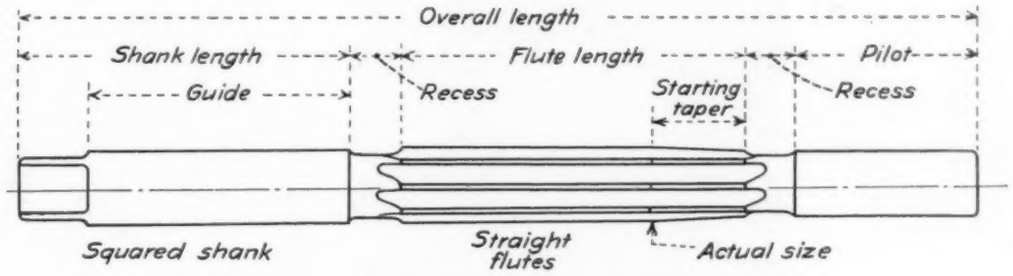
New Departure

BALL BEARINGS FOR DEFENSE

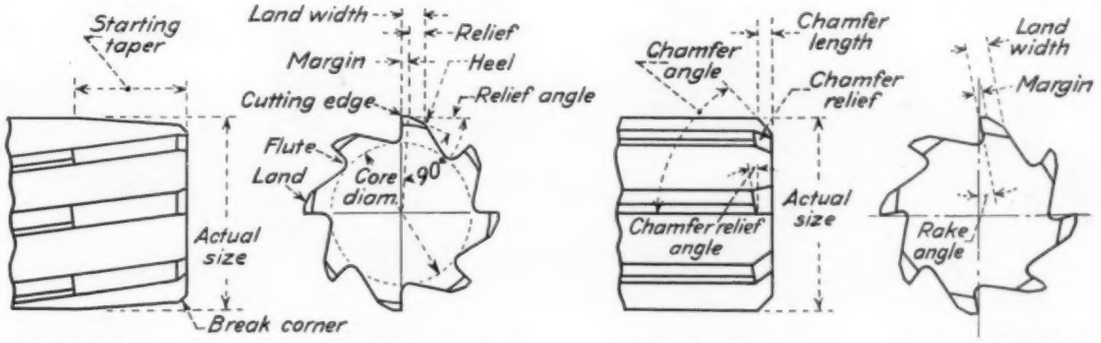
Reamers—Terminology and Definitions—II



Chucking Reamer, Straight and Taper Shank



Hand Reamer, Pilot and Guide



Helical Flutes Left Hand Helix Shown

Radial Face (0° Rake and Right Hand Rotation Shown

Hand Reamer Point

Straight Flutes Shown

Rake Angle and Right Hand Rotation Shown

Machine Reamer Point

Tapping Trouble?

CHECK THESE POINTS

If your taps are breaking, or not cutting smooth, proper size threads, it may not be the taps' fault. Here are a few things to check to help you locate and correct tap trouble

TYPE OF HOLES TO BE TAPPED

If a blind hole, is there sufficient untapped space at the bottom for the accumulation of chips?

Is a "Gun" tap that shoots the chips ahead being used? (In a blind hole tapped very nearly to the bottom and having no recess, the "Gun" tap is not recommended.)

Do conditions call for a two or three fluted tap?

CLASS OF FIT REQUIRED

If the tap produces an oversize hole, has the proper tap been selected for the class of fit desired?

If proper tap is being used, is there any play in the work or tap holding spindles (provided rigid spindles are being used)?

Do the work and tap line up accurately?

Is the tap dull?

TYPE OF MACHINE

Is drive uneven because of slipping belts?

Is machine powered properly?

Are tap and drilled hole in alignment?

Is there undue wear on sliding parts?

TAPPING SPEEDS

Is the speed too slow?

Is the speed too fast?

TAPPING DIFFERENT MATERIALS

Has the tap proper cutting face for the particular material being tapped?

Is the tap of the proper design or type?

PROPER HOLE SIZES BEFORE TAPPING

Is the drilled hole of the proper size?

Is the drilled hole perfectly round?

Is the axis of the hole parallel to the axis of the tap?

LUBRICATION

Has the proper lubricant been employed?

Does the lubricant flood the tap sufficiently while engaged in the hole?

Is there sufficient force behind the lubricant to wash away the chips?

If applied with a brush has the lubricant a sufficiently heavy body to adhere to the tap? (A light lubricant will be thrown off the revolving tap before it enters the hole.)

TAP HOLDING DEVICE

Is worn or wrong type of holder being used?

Is holder in alignment with drilled hole?

CHAMFER

Is the point diameter of tap correct for the size of hole being tapped? Does the tap enter the hole an excessive number of threads before taking hold, thereby losing the full benefit of the entire chamfered portion?

Is the chamfer the correct length?

Is the chamfer chipped or dull and in need of regrinding?

Is the chamfer relief too great or not sufficient?

This is one of a series of advertisements published by Greenfield Tap & Die Corporation to help users get greater production from their small tools in these critical times, through making useful facts more widely known

"Maxl" Tap, for abrasive metals
"Gun" Tap for through holes in stringy metals
Standard Tap for average production operations

GREENFIELD TAP AND DIE CORPORATION
GREENFIELD, MASSACHUSETTS
DETROIT PLANT: 2102 West Fort St.
WAREHOUSES in New York, Chicago and Los Angeles
In Canada: GREENFIELD TAP & DIE CORP. OF CANADA, LTD., GALT, ONT.

GTD GREENFIELD

TAPS - DIES - GAGES - TWIST DRILLS - REAMERS - SCREW PLATES - PIPE TOOLS

Wanted: Trained Management

OF ALL the skills needed in the defense effort, the one of which we are the shortest is managerial talent.

That fact may seem strange on first thought, but it is easily explained. American industry had not turned its hand to munitions manufacture for more than twenty years; and managements familiar with armament production at the beginning of the defense program could have been counted on your fingers.

We are treated to the unusual sight of seeing Procter & Gamble, a soap maker, given the responsibility for running a government plant in which shells will be loaded. Goodyear Tire & Rubber, identified commercially with various rubber products, and Johnson & Johnson, producers of medical supplies, will operate bag-loading plants for Uncle Sam. Johns-Manville will manage a shell-loading plant.

Why such selections? For only one reason—these companies may not be familiar with the particular product which they are asked to make, but they possess the managerial "know-how." If they have that, they are well on the way toward doing what the government wants them to do.

That is why the automotive industry has been given so much armament work. The great contribution of motor car makers to aircraft is not plant and tool facilities, but long experience in a related line of manufacture.

There may be shortages in semi-skilled and skilled men for defense industries, but the biggest shortage is in supervisory help. Trained intelligent foremen are hard to get. Some companies have had to resort to double-duty for their supervisors simply because the number of them wouldn't go round.

This acute dearth of managerial personnel is not attributable to any one factor. It is due to several. One is the tremendous and sudden growth of the munitions industry. Another was the understandable drop in interest in training new foremen during the depression years. Still another is the high rate of supervision needed in armament production.

One of the country's large corporations, now up to its neck in defense work, has discovered that the manufacture of munitions, with which its employees are relatively unfamiliar, takes three times the supervision that production of its normal peacetime products takes. That means a further drain on the already dwindling supply of foremen.

What conclusion? Good foremen are a scarce commodity. If you have a heavy demand for steel, let us say, you immediately get busy and produce more. The same is true of shirts or of food or of any commodity. Why not follow the same procedure with foremen when the demand exceeds the supply and when the need promises to be even greater?

Unfortunately it is the nature of most people and of most industries not to do anything to meet a problem until it is upon them. Then it is often too late to do a good job, and one must be satisfied with improvisations. Already the time is late to start training foremen, if you don't already have a training program. However, unless more companies get busy, the defense industries will be saddled with a supervisory problem in defense manufacture which will do more than give them a headache. It will cost them thousands of dollars in decrease plant efficientcy and will make increasingly difficult the task of producing goods which call for precision manufacture.

Burnham Finney

GAGING BUSINESS

Expect to produce about $1,000,000,000 of machine tools during the 1941–42 fiscal year; all-time monthly high recorded last June with $63,000,000 output. Plane production also hits monthly record

Machine Tools—The machine tool industry expects to produce close to $1,000,000,000 of machines in the fiscal year which began July 1. During June its output rose to an all-time high of $63,000,000, which compares with $60,800,000 the previous month. Shipments in the first half of the current year totaled $346,900,000, as against $425,000,000 in all of 1940 and $125,000,000 in 1938. Despite the high level now, operations still are expanding weekly as new plants start work, as second and third shifts grow, and as more subcontracts are placed by machine tool builders. Among companies now making machine tools, or parts, are the Mohawk Carpet Works, Amsterdam, N. Y., Fisher Body, Detroit (building planers); American Can Co. at several plants; Westinghouse; Hoe and Miehle, printing press manufacturers; and the Draper Co., Worcester, Mass., maker of textile machinery. Orders for the bomber program, largest single project now before the industry, are coming out in increasing volume. Lease-lend requirements, estimated at 25,000 or more machines, are slow in reaching the contract stage. Superseding in urgency even the bomber needs are machines for anti-aircraft equipment plants and for small arms ammunition factories. The new priority rating system put into effect by OPM, showing the "urgency standing" of each contractor in each priority classification, has meant that all machine tool builders have had to rejuggle their production schedule boards, and seemingly they must rejuggle them again every thirty days. Unless new and staggering armament programs are launched, which require the construction of huge new plants and of large additions to existing factories, the end of a billion-dollar-a-year machine tool business is in sight almost before it arrives. Many companies have bookings at full capacity until July, 1942, or longer. But all builders are not under equal pressure; some can quote today deliveries as early as October and November. After the peak has passed, the industry believes demand will fall off onto a relatively high plateau where it will remain for the duration of the war. There will be a continuing job of plugging up the weak points in munitions lines with higher-production, low-cost machines after the initial tooling up scramble has ended.

Aircraft—June plane production was 1,476 units, or 150 above the May figure and within a few units of the 1,500 quota set for the month late last summer. The North American strike is estimated to have reduced output by 70 planes, mostly advanced trainers. Limiting factor in airplane output today appears to be propellers and comparatively minor parts and accessories. Many plants have substantial quantities of planes on hand finished except for some essential part. Martin, for instance, is reported recently to have had more than 50 B-26 medium bombers waiting for propellers and turrets. World production of planes, according to best available estimates, is around 8,000 planes a month, divided thus: Germany, 2,500; Russia, 2,000; Britain, 1,800; United States, 1,500; Japan, 300; Italy, none except parts; and small amounts in British dominions and non-German Europe.

Railroad Equipment—Locomotive buying is expected to spurt. Carriers are planning to add 270,000 new cars in the next two years, 120,000 by next summer. A large increase in motive power will be necessary to take care of the traffic load for which these cars are being purchased. On July 1 railroads owned 39,496 steam locomotives and 1,759 diesel and electric engines. About 300 new locomotives now are on order. The preference rating order for locomotive steel will be A-3. A like rating was given recently to 60 freight car builders.

Munitions—With defense appropriations for the new fiscal year barely signed, the President asked Congress this month for nearly $6,500,000,000 more for the Army and Navy. By far the biggest chunk is for Army Ordnance—$3,486,000,000. Little is known as to the distribution of this money, except that it represents a decision to proceed immediately to procure critical equipment for an army of 3,000,000 men. Navy Ordnance is to secure $250,000,000, mostly for plant construction; $70,000,000 of it will go into a plant to make a new secret explosive. Facilities for manufacture of armor plate will be expanded at a cost of $114,000,000. Last month the War Department was obligated by contract or letter of intent for $5,000,000,000. Half of it was for the Air Corps, $1,500,000,000 for Ordnance. Britain needs medium tanks more than almost anything else; for that reason U. S. makers are preparing to go onto a three-shift basis. Continental Motors last week shipped its first airplane-type tank engines from its Detroit plant.

Steel—Non-defense customers are finding it almost impossible to get alloy steel and are having extreme difficulty in obtaining even carbon steel. The pinch is so great that many users may be expected to take on defense orders to keep on operating at all. Steel mills are forging ahead somewhat reluctantly with expansion of capacities in certain tight commodities.

Courtesy Business News Section, The New York Times

Five states—Washington, Virginia, Maine, Oklahoma, and California—have received defense contracts equal to more than 50 per cent of their entire manufacturing output in 1939. Fourteen states have received contracts which total over 21.1 per cent of manufactures for the same year. The defense contract figures used herein do not include construction awards

SUBDIVIDE A-1 MACHINE TOOL PRIORITY RATING

Greater protection afforded tool users; changes made in blanket ratings tighten up rules under which needed materials are bought

BY ROBERT COLBORN

WASHINGTON—As far as machine tool orders are concerned, it has now become necessary further to subdivide the A-1 priority rating. In addition, changes have been made in the regulations to protect tool users from having their tools snatched away, just as they're about to be delivered, by higher priority customers. Finally, important changes in the blanket ratings assigned to tool builders tighten up the rules under which they buy the materials they need.

A few months ago, the A-1 rating was subdivided: A-1-a, A-1-b, and A-1-c. Now in effect another letter has been added to distinguish between different tool users with the same rating. Mechanism for doing this is a so-called "Master Preference Numerical List." This semi-confidential document is a list of more than 500 munitions contractors who are in urgent need of tools, listed in the order of importance of the projects they have underway.

Tool Builders Get Preference

When a tool builder has a number of orders with, say, an A-1-b rating, he will give preference among them; first to orders from other tool builders and from makers of cranes, cutting tools, gages, micrometers, and chucks; second, to customers on the numerical list in the order of their position on the list; finally to orders from customers not on the list. An A-1-a rating, no matter who placed it, would take precedence over any of these A-1-b ratings.

A major headache for both tool builders and tool users has been that under the priority system it's never possible to tell who's actually going to get a tool. On the very day that a tool bought on an A-1-d rating is to be delivered, someone can walk in with an A-1-a rating and snatch it off the floor. A new rule has been adopted to give some relief from this practice.

Under the new rule, a period of grace is established, after the receipt of a high rated order, during which it is not required that the tool builder rearrange his production and delivery schedules. This period is thirty days except in the case of the following tools for which the period is sixty days: tools individually engineered for special operations; automatic lathes; chucking machines; horizontal boring, milling, and drilling machines; internal grinding machines; milling machines; multiple spindle screw machines; precision boring machines; reaming machines; rifle barrel chambering, drilling, reaming, and rifling machines; thread grinding and milling machines; turret lathes and vertical boring mills.

The effect is that when a tool is within thirty or sixty days of completion, as the case may be, the customer can be assured that he will get delivery. However, although it is not explicitly stated, it is understood that orders placed by tool, gage, and crane builders will not be subject to the period of grace.

The disruptive effects of tool snatching (inherent, of course, in any priority system) have been especially serious since the inauguration of the heavy bomber program. This project has been granted a rating (A-1-b) two steps higher than that attached to most other Army aircraft, and scheduling of tools for plane manufacturers has become almost chaotic.

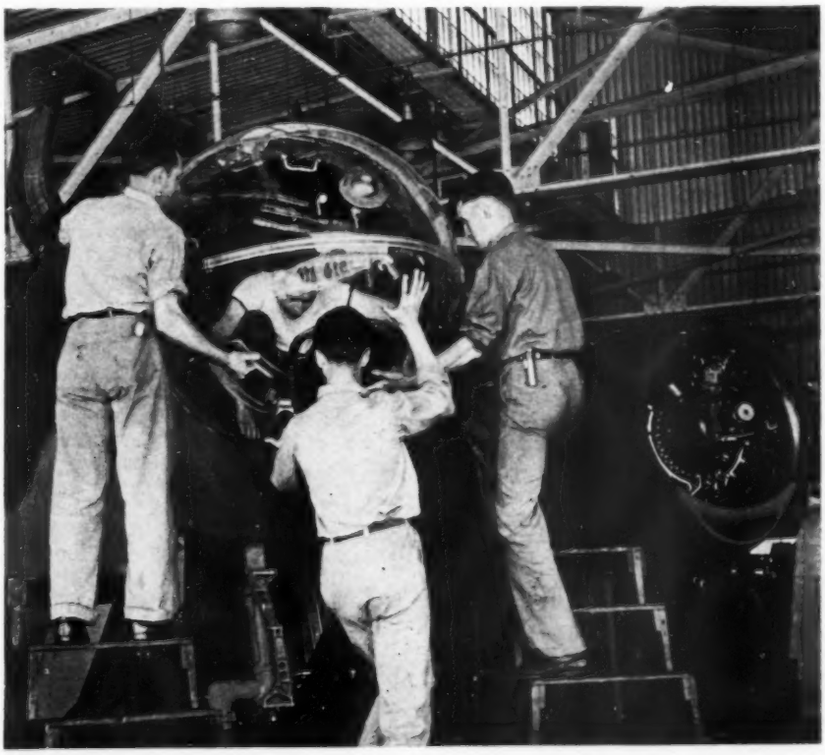
Meanwhile, some modifications have been made in the blanket ratings under which tool builders buy the materials they need. Formerly all tool builders were given an A-1-a rating; now only some get this rating, while others get A-1-b and A-1-c. The rating moreover applies only to materials needed for specified tools built by the firm in question. Another change provides that subcontractors may extend the blanket rating to their suppliers.

The new blanket ratings may be applied to purchases of the following:

Motors and other electrical equipment; alloy steels in bars, forgings, castings, and tubes; iron, steel, and aluminum castings; machine parts and equipment; cutting tools, including cemented carbides; abrasives; measuring instruments and gages; brass, copper, and steel tubing and fittings; oil resisting hose. Foundry supplies consisting of: steel rail and other steel scrap; silvery pig iron; regular pig iron; coke; ferro-silicon; ferro-manganese; vanadium; nickel, molybdenum, chromium.

MACHINERY IMPORTS DROP

WASHINGTON—Imports of industrial machinery into the U. S. in 1940 were valued at $4,125,661, a 48 per cent decline from the 1939 total of $7,893,152, it is reported by the U. S. Department of Commerce. Imports from Germany, which is usually the principal supplier of this type of equipment, dropped from $3,639,354 in 1939 to only $175,335 in 1940. Approximately 25 per cent of all U. S. industrial machinery imports in 1940 consisted of textile machinery.



Windows for Bombers—*Hundreds of medium bombers (B-26) are being turned out at the Glenn L. Martin plant under defense contracts. When the ships are nearly completed, a plexiglas nose and windows are put in each as above*

FDR Requests 566 More Cargo Ships Pushing Maritime Commission's Program to Over 1,200

WASHINGTON—President Roosevelt's request to Congress last week for $1,246,650,000 for 566 additional cargo ships, brings the total Maritime Commission program to over 1,200 vessels, which, because they are bigger and faster, will equal or exceed the 2,300-ship fleet of World War I in carrying capacity. Further, a new oil tanker project is being considered by the Administration, to meet the critical British demand, which has taken 100 tankers off our own East coast shuttle.

In the matter of speed, the current rate of building is far ahead of World War I days. The present rate of delivery, considering both "C" and "EC-2" (emergency) designs, is almost two a week. By November it will be four or five a week. And in later 1942 or early 1943 two ships will slide down the American production line every day.

Large Tonnage Increase

Tonnage to be constructed in 1942 has been increased to 5,593,249 from the 3,500,000 tons originally planned; private construction will add 585,800 tons. Output in 1943 will be 6,366,671 tons with private sources producing 186,200 tons. Thus the U. S. shipbuilding program will more than equal British current losses of 6,000,000 tons annually by 1942, breaking the shipping shortage.

To facilitate speed, the Priorities Divison of OPM last week issued blanket preference ratings to about 20 ship yards now building ship ways. The preferences are to be used only for material going into the ways, and for certain specified equipment to outfit the ways for production of ships. All of the ways covered by the preference are ways being built under contract with the Maritime Commission. For ways that will complete ships in 1942-43, the rating is A-1-b. The materials are covered by the rating only if they are included in the Priorities Critical List, or on a special list of materials attached to the order. It covers portable or stock tools, but not machine tools; these must be acquired in the usual manner, by means of individual rating certificates.

A blanket rating, recently ordered for materials going into the ships themselves, is A-1-a on vessels for delivery this year; A-1-b for delivery in 1942; and A-1-c for 1943. These priorities assure the builders prompt delivery, especially of plate steel.

Blanket ratings are given to 24 ship construction companies, whose contracts total 289 ships, soon to be increased under the new program. Ratings also are given to agents of the Maritime Commission who are handling purchase of equipment for EC-2 hulls. Machine tools are not covered, as in the case of ratings for ways.

There are now 79 shipways provided in the nine yards building EC-2 vessels. More than half of these yards, which are located on both Coasts and the Gulf, are in operation, and the remainder will be completed early this summer. Very soon there will be in operation a total of 29 yards with 186 ways building both "C" and "EC-2" regular and emergency designs.

In 1936 there were but 10 shipyards in the country, in some degree of activity, with only 46 ways capable of taking 400-foot ships, and large proportion of these ways were being used for naval construction. Thus, the nation's merchantman building capacity has increased four-fold in four years.

All of the ships in this expanded program are to be completed and in service by the end of 1943. This program, plus ships being built for private account and for British account in U. S. yards, contemplates delivery of about 14,000,000 deadweight tons by that time, out of American yards. Total tonnage under order is about 8,160,000 tons.

Of the 1,200 ships in the new program, 750 are of the emergency EC-2 design. Of the 566 in the new program, 418 will be EC-2; 24 will be C-3; 42 will be C-2; 18 will be C-1; 39 will be a modified C-2 designed for building on and taking out of the Great Lakes; and 25 ocean-going tugs.

Cost Over $3,000,000,000

The new program, and that already under way, brings the total cost of emergency shipbuilding to approximately $3,110,000,000. This does not include any appropriations asked or made for purchase and repair of existing ships, foreign or domestic, or any of the $350,000,000 allocated in Lend-Lease funds for the Commission.

Launching of the African Comet, all-welded vessel for the American South African line, signalizes the saving of a half million tons of steel in the expanded program. Entire ships are now being turned out without a single rivet. The main objective in welding is seven to eleven percent saving in weight, which, of course, saves that much steel and increases the cargo capacity.

You can't count the entire bulk of rivets as weight saved, because the shaft merely fills a hole, but the heads and points add up fast, and so does the saving in eliminated overlap; most ship welding is butt-jointed. Welding apparently does not save labor or cost. It does seem to add from two to five per cent to speed of the ship, but this is difficult to prove. Models towed in a basin do not produce full-scale turbulence; and tests of full-size hulls at sea have to deal with many variables such as currents, winds, roughness of bottom. Welding is water and oil tight, eliminates trouble and expense of bilge water. All riveted ships leak.

TO INCREASE MAGNESIUM

WASHINGTON—The current expansion program for magnesium designed to raise U. S. production to 600,000,000 lbs. annually will be increased soon by another 200,000,000 lb. addition. Current magnesium production is 36,000,000 lbs. It is estimated that 600,000,000 lbs. of magnesium are needed annually for defense contracts now in sight. Meanwhile, as OPM officials continue to discuss this expansion, the War Department is negotiating with seven manufacturers to build government-financed plants to produce 325,000,000 lbs. of magnesium annually under the first program. The use of this metal has increased tremendously since the defense program.

U.S. Fleet of Gigantic Bombers Being Designed

WASHINGTON—Long range heavy bombers nearly twice the size of the "flying fortress" type are to be included in the new program to bring heavy bomber production up to 500 a month. In addition to the Boeing B-17 and Consolidated B-24, two other ships are in the program, Boeing's B-29 and Consolidated's B-32. Little is known about these planes, which are still in the design stage, but they are believed to be in the 40-ton class (as compared with 25 to 28 tons for present four-engine equipment) and presumably will be powered with the 2,300 to 2,500 hp. engines expected to be available next year. Although production of these two ships is doubtless some time away, priorities have already been granted for the necessary materials, tools, and accessories.

A third ship of this class which is believed to be under consideration though it has not yet been definitely included in the program is the Lockheed B-49, a military version of the Constellation transport, three of which are now being built for TWA.

Except for the contract with Ford, who is to build 85 Consolidated B-24's a month, not much has yet come out as to automotive participation in the big bomber program. However, it is clear that contracts so far announced represent only a part of the 500-a-month objective. It now involves operations at Ford's Ypsilanti plant, Boeing's Wichita, Douglas' Long Beach, and Lockheed's Vega plant. Expansion will bring the auto firms in prominently.

It may be that this phase is waiting on first results of automotive manufacture of subassemblies for the mid-western assembly plants. Although they have given up talking about it, some plane manufacturers are still very skeptical as to that experiment, and think they may yet find themselves doing all the work.

Light on the Subject—*Next to good tools, the machinist needs good lights. Accordingly, many plants have equipped their machines and inspection lines with localized lighting units. Such a unit, made by Fostoria Pressed Steel Corp., is being used (above) on a grinding machine*

Present Methods Unable to Stop Price Rises; Executive Orders, New Legislation to Follow

WASHINGTON—The government has failed to stop the boom price spiral. Hard boiled OPACS Administrator Leon Henderson, with nothing but publicity threats and empty plant seizure and material stoppage threats as weapons, has been challenged. First, openly by Chrysler, then by the powerful farm block because of cotton yarn ceiling, and now by the cotton cloth industry, which is in Washington howling for modification of the ceiling schedule. The President has come to Henderson's aid with a proposed law in his pocket. The battle is on.

You can feel pretty sure of one thing: there will be several laws and executive orders, not just one (the Baruch plan) to freeze all prices as of a given date. That might come in a year or two, but not now. The Administration is afraid to risk losing all in such a venture. Rather, it may try to enact penalties to continue Henderson's selected commodities program. The President said at his press conference last week that price freezing depends on the article, or even on the commodity.

Almost every phase of the legislative battle will stir up a hornet's nest. Agriculture will stick up for higher prices on produce, and probably will win. Realestaters will plead increasing costs for higher rents. Request for powers to suspend import duties will be opposed from every point of the manufacturing compass. No wage control is in sight now, but the big guns of labor will roar when that issue lifts its head. Until then, the cost of restraining inflation will have to come out of profits.

Only a cum laude economist would try to forecast the effect of price control on the metal-working industries. Already you have seven of the total eleven ceiling schedules on metals: aluminum scrap, zinc scrap, scrap iron and steel, steel, secondary materials containing nickel, and pig iron, plus used machine tools. There have been no public squawks under these ceilings. Then, not covered at all, are aluminum at 17 cents, the lowest figure in history, and copper at the moderate figure of 12 cents. The government has held both of these items in line simply by tossing them a dirty look.

Indications are that the government will have little trouble in keeping control on the prices of the defense metals. Even if the prices went sky high it would make no direct difference to defense contract manufacturers, because the government pays the bill. It would make a tremendous difference to non-defense manufacturers, who still constitute 85 per cent of total activity.

As for civilian metal products: refrigerators, tools, cars, trucks, farm machinery, it can only be said that volume will be curtailed. And the experts here think some price increases will be necessary to make any profit for the manufacturer.

HUGE AIRCRAFT CONTRACTS

WASHINGTON — Wright Aeronautical Corp., Paterson, N. J., received contracts for engines and parts last week totalling $161,026,089 while Curtiss-Wright Corp., at Buffalo, N. Y., and Caldwell, N. J., was awarded contracts for $116,234,106. Other aircraft contracts were: Lockheed Aircraft Corp., Burbank, Calif., $92,602,290; Douglas Aircraft Corp., Inc., Santa Monica, Calif., $44,857,948; Vega Airplane Co., Burbank, Calif., $26,051,760; General Motors Corp., Indianapolis, Ind., $41,366,880; Nash-Kelvinator Corp., Detroit, $15,237,500; Pump Engineering Service Corp., Cleveland, $3,253,450; and Fairchild Engine & Airplane Corp., Hagerstown, Md., $1,037,543. General Motors was awarded $27,823,008 for guns; American Locomotive, Schenectady, N. Y., $26,725,000 for tanks; Sperry Gyroscope Co., Brooklyn, $80,000,000 for instruments and Fargo Motor Corp., $11,236,975 for trucks.

Move to Conserve Nickel Steel Scrap as Supplies Fail

WASHINGTON—Realizing that the only source of additional nickel now available is in the scrap piles of users, a joint effort has been instituted by OPM and by the alloy steel scrap conservation committee of the American Iron & Steel Institute to conserve nickel steel scrap.

The Institute's committee has circularized big users of nickel steel to see how much scrap is not being put back into proper use. It also is conducting a survey of methods of preparing scrap to determine what means are now being used and those which could be employed. The purpose is to classify nickel scrap into a number of segregated groups.

Many users who have not bothered to put aside their nickel scrap and have sold it as ordinary scrap will find that the extra cost of classifying it will more than pay for itself in the extra price secured from scrap dealers. It is probable that some extra inducement, in the form of higher commissions, will be held out to scrap dealers to get them to ferret out the available nickel scrap.

Defense requirements for nickel now run around 12,000,000 lbs. a month. If non-defense needs are added, total nickel demand is about 21,000,000 lbs. a month. Yet only 15,000,000 lbs. is available. Shortly defense needs are expected to rise above productive capacity. The International Nickel Co. has under way a $30,000,000 expansion of nickel mining in Canada, but the benefits of this program will not be felt for two years.

Find Power and Labor Supplies Becoming More Scarce as Canadian Production Speeds Up

MONTREAL—Although every type of equipment for war which Canada plans to produce will be in production by September, two problems are becoming increasingly important, the supply of labor and fuel. Nearly 500,000 men and women are now employed directly or indirectly in war industries of a total population of 11,000,000.

During the next few weeks the government will undertake an intensive survey of all available man power to estimate the potential labor supply for war industries. Recommendations made as the result of the survey will form the basis for probable drastic measures to utilize man power to the best advantage for war purposes.

In an effort to conserve electric power supply, the government last year ordered continuance of Daylight Saving Time in industrial provinces. Because of the greater demands for power resulting from opening of the new war plants the problem will be more serious in the coming year. Rationing, or a restriction on use of power by non-essential industries, has been suggested.

Fail to Expand Power Industry

The problem is the direct result of a failure to expand the power industry. It is indicated that private companies hesitate to expand their facilities at available sites because of the proposed St. Lawrence power project. As this would create a large power surplus in a few years, the private capital invested now in power development would practically be lost due to the great decrease in demand. At the moment the largest power development is a $30,000,000 project on the Saguenay River which will provide power for the plants of Aluminum Co. of Canada which are rapidly being expanded.

To meet the pressure for higher wages, Canada now calls for mandatory payment of cost-of-living bonuses in plants engaged on war work or in essential services. Under the system which has now been extended to 143,000 workers on the Canadian railroad and recommended for the 3,000,000 workers in all industries, a bonus is paid amounting to 25 cents a week for each rise of a point in the government cost-of-living index. Juvenile and female workers earning less than 50 cents an hour get one per cent of their basic wage rate. Through June 1 the government index had risen 8.6 since the outbreak of the war. Where a bonus has been awarded, another bonus cannot be arranged until the index has risen a further 5 points, at which time $1.25 a week is added to pay checks at once. This policy has been adopted to "freeze" wages at war plants at the present levels. Inasmuch as the government bears the cost of higher wage costs in war contracts, such action was deemed essential to avoid development of the very serious financial problems for the government.

Under supervision of the government-owned company, Research Enterprises, Ltd., preparations are being rushed for the production on an extensive scale of Britain's famed radiolocator, which warns of approaching planes when they are still miles away. The company's orders total $40,000,000.

Sorel Industries, Ltd., Sorel, Quebec, is speeding up production of 25-pounder guns, the first of which came off the assembly line about a month ago. This plant is the only one in Canada where guns and carriages are being produced complete from scrap iron to the finished product.

During the past two years the Department of Munitions and Supplies has placed over 100,000 contracts on Canadian account totaling $300,000,000. Some of the latest contracts include:

Aircraft: Aviation Electric, Ltd., Montreal, $201,426; Canadian Vickers Ltd., Montreal, $197,454; Canadian Wright Ltd., Montreal, $262,440; National Steel Car Corp., Ltd., Montreal, $27,500,000; Noorduyn Aviation Ltd., Montreal, $241,750; and Bristol Aircraft Products Ltd., Montreal, $226,550. Shipbuilding: The Robert Mitchell Co., Ltd., Montreal, $127,900; Star Shipyard Ltd., New West Minster, B. C., $129,950.

SELECT ALUMINUM COMPANIES

WASHINGTON—The Office of Production Management has recommended five companies to operate new government-owned aluminum plants to produce an additional 600,000,000 lbs. of aluminum annually. In addition OPM has recommended the construction of a plant, likewise to be owned by the government, and operated during the emergency by the Aluminum Co. of America, for the production of 400,000,000 lbs. of alumina annually. Construction of these plants will raise the aluminum capacity of the U. S. to 1,400,000,000 lbs. annually. Imports from Canada will raise the total supply available to 1,600,000,000 lbs. The companies are: Aluminum Co. of America, 100,000,000 lbs., Arkansas; 90,000,000 lbs., Bonneville-Grand Coulee area; 150,000,000 lbs., Massena, N. Y.; Union Carbide & Carbon Co., 60,000,000 lbs., Spokane, Wash.; Reynolds Metals Co., 100,000,000 lbs., Listerhill, Ala.; Bohn Aluminum & Brass Co., 70,000,000 lbs., Los Angeles, Calif.; and Olin Corp., 30,000,000 lbs., Tacoma, Wash.

Government Commitments For Plant Expansion Soar

WASHINGTON—Commitments for defense plant expansion at the end of May had risen to a total of $3,061,000,000 covering 1,847 projects, the Bureau of Research and Statistics, Office of Production Management announced recently. In addition, application had been made for Certificates of Necessity on plant facilities totaling $281,000,000 upon which action had not been taken, bringing the total to $3,342,000,000. Government obligations comprise 75 per cent of the money allocated, and 22 per cent of the projects in this tabulation. This does not include private projects for which Certificates of Necessity have not been requested.

Government commitments as of May 31 cover 397 projects estimated to cost $2,291,000,000 while private commitments at the same date cover 1,450 plants estimated to cost $770,000,000. Of the total government commitments, $927,000,000 represents the share of the Army and $730,000,000 represents the Navy's commitments. The Defense Plant Corp. has commited itself for $505,000,000. Other government commitments total $129,000,000.

N.A.M. Survey Finds Industry on Schedule

WASHINGTON—U. S. defense industry is "on schedule or ahead" of governmental requirements, it was indicated recently by the National Association of Manufacturers after a survey of 16 major defense producing areas. NAM disclosed that $51,575,000,000 is the extent of the U. S. commitment to date for defense. Of this, $40,869,000,000 will come from U. S. general funds; $7,000,000,000 from the Lend-Lease Act; $3,706,000,000 is in the form of British orders. Annual expenditures will be: 1940—$1,884,000,000; 1941—$17,000,000,000; 1942—$23,000,000,000; 1943—$9,891,000,000.

Out of several hundred defense producing manufacturers, the various surveys indicated that 31 per cent are expected to deliver on time; only 27 per cent reporting that they had been asked to advance delivery dates because of the urgency of the situation. A sharp drop in delays due to machine tool shortage was noted; 63 per cent of the manufacturers complained of tool shortages in January, only 29 per cent in May.

Material shortages continue at a high rate, an average of 80 per cent of the responding manufacturers stating that this constituted a major obstacle. In analyzing the labor supply situation, an indicated increased need for skilled workmen was evidenced. In January, 45 per cent of the reporting manufacturers needed skilled labor, in May, 56 per cent.

INSIDE DETROIT

Strong opposition developing to the government's plan to curtail auto production further. UAW-CIO proposes tripartite conference to work out a program preventing severe unemployment

BY RUPERT LE GRAND, DETROIT EDITOR

DETROIT—Powerful opposition has arisen to the government's avowed determination to curtail auto production once more, especially since it is feared that widespread temporary unemployment is unavoidable even under the original OPM program.

Gov. Van Wagoner of Michigan has appealed to the President to avoid sharp curtailment in auto production with the onset of the 1942 model season, and asks that the original 20 per cent cut not be exceeded. Basis for the Governor's plea lay in a report made to him by C. C. Carlton, president of the Automotive Parts & Equipment Mfgrs. Association, and member of the Michigan Council for Defense. Mr. Carlton foresaw loss of jobs to 60,000 auto workers in Michigan, and 155,000 in the nation between August and November through inability of defense work to take on displaced automotive personnel. (Most observers agree that defense will not reach a high employment rate until winter). This situation arises because under the original OPM order, production in the six months beginning Aug. 1 (the start of the 1942 model season) is limited to 80 per cent of output in the first six months of the 1941 model season. Since the lion's share of output occurred in the latter half of the production year, Mr. Carlton estimates that curtailment this fall will actually amount to a 38 per cent reduction from levels in recent months.

UAW's New Plan

Labor has stepped into the arena, accusing government and industry of denying it legitimate representation in formulating policies, and relegating it to "the role of a servant to merely carry out orders, and suffering the consequences of policies which it was granted no part in formulating." The international executive board of the UAW-CIO adopted a resolution urging that a joint conference representing automobile management, labor and the government be held to work out a program to avoid "dislocation of the industry".

High spots of the UAW-CIO proposal are:

1. Curtailment to be made gradually and timed in relationship to increase in defense work, so as to permit diversion of employment from one to the other without loss of employment to individual workers.

2. It is the obligation of government to guarantee workers against loss of jobs or earnings, to make provisions for their employment, to reimburse them for loss of pay.

3. That the joint conference of auto industry, labor and government should consider:

(a) The Murray plan to insure maximum use of steel production facilities.

(b) Divert steel and other defense materials from non-defense industries on an equitable basis so as to relieve pressure on the auto industry.

(c) Stagger curtailment of auto production over a long period to permit completion of tooling necessary to shift from automobile production to defense production.

(d) Industry-wide coordination of tooling facilities to insure maximum use of skilled help and equipment, and concentration on specific tooling jobs timed with the staggering of auto production curtailment.

(e) Transfer workers to defense on basis of seniority within a community or metropolitan area. No new employees to be hired on defense jobs until seniority employees, who are able to do job, or who can be transferred, are first employed.

(f) Plan defense-worker training in advance to fit in with staggered curtailment of auto production and completion of the defense tooling.

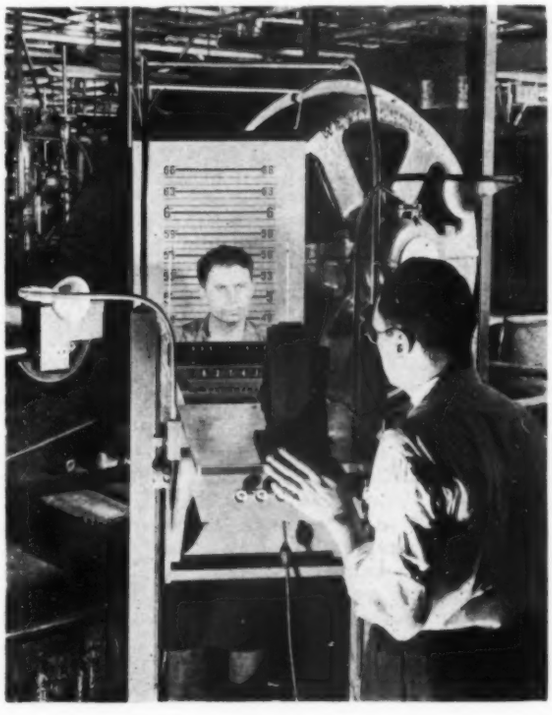
(g) Wage rates on defense comparable to auto rates, to insure no decrease in earnings and standard of living.

(h) Placement of defense contracts to be made in consideration of the above points.

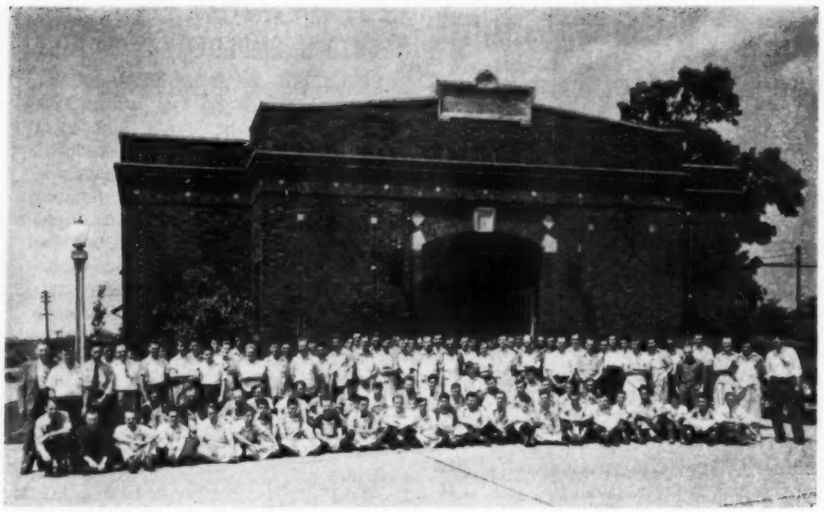
Walter Reuther, author of the plan to make 500 planes per day in pooled automotive facilities, had a large hand in drawing up the UAW-CIO resolution for a joint conference. His original plan was probably the smartest publicity stunt in a decade, and that statement is not made to question his integrity. Shelved by discreet action of the OPM, the plan cannot be called dead. Still very much alive, its underlying purposes are: joint management-labor control of the auto industry, or even labor control, when aided by consumer and government groups. That

AUTO UNEMPLOYMENT TO RISE

DETROIT—Labor needs on defense work assigned to the automotive industry will be insufficient even by next June to absorb all of the workers who will lose jobs from the original cut in production for the 1942 season. The government was appraised of the facts months ago. Auto companies are exerting strong pressure on the government for defense contracts to take up slack in employment and make use of facilities, but orderly letting of contracts requires a rather long period of time.



Precautionary Measure—*New photo identification badges are being made for all employees in the auto industry. The portable equipment (above), used by Chevrolet, is capable of 200 pictures per hour. A serial numbering device records the date and the employee's social security number*



Wholesale Training—*When Wright Aeronautical Corp. began to build its new plant at Lockland, Ohio, there was no school available in the vicinity to train workers for the new jobs. Charles R. Hook, president, American Rolling Mill Co., Middletown, Ohio, converted the garage behind Armco's main office building into a school. When Wright supplied the machinery, the metamorphosis was accomplished quickly. Some of the students are pictured in front of the school (above)*

OPM LABOR SUPPLY BRANCH

WASHINGTON—Stirred into action by Roosevelt, the Office of Production Management's Labor Division has set up a new labor supply branch which will essay to fill all skilled labor and manpower requirements in expanding defense industry. Over 1,418,000 more men will have to be put to work by April 1, 1942, on defense production alone; over-all labor needs are between 2,500,000 and 3,000,000 for the same period. The 1,418,000 figure is on the basis of existing contracts and will be increased. The labor estimate is: shipbuilding — 323,900; aircraft — 408,441; ordnance and machines— 391,607; and 384,000 for all others. There is a possibility that labor priorities may have to be instituted just as raw materials already have been put on a priority and allocation basis. About 1,424,000 men had been trained in the defense program to date; 60 per cent of that number are now employed.

it would be dusted off and brought forward in new form has been apparent to auto executives, when an outcry could be raised against industry or government for botching defense.

The UAW-CIO is not satisfied that the auto industry has done its level best defensewise, and it is ready to make cracks at the government, the Army and the Navy for the manner in which the defense program has been handled. Plenty of "evidence" has been secured to use in the joint conference proposed. If that conference is sidestepped, the union findings will be carried to the Administration and the public. Look for a strong campaign by the union.

OPM Appoints Auto Representatives

Meanwhile, in Washington OPM is endeavoring to set up an Automobile Advisory Defense Committee, and has already appointed passenger-car and truck representatives. Eight additional members from the parts industry will be chosen after a meeting of 60 to 70 firms representing that industry. It shall be the duty of this advisory committee to suggest allocation of production among the several manufacturers under a new and more drastic curtailment program given consideration because of the materials supply question. No indication of the amount of further curtailment has yet been received by the auto industry. Sidney Hillman is attempting to set up a "labor advisory committee" to parallel the manufacturers' committee. OPACS is working independently on the problem. Leon Henderson called a meeting last Tuesday of representatives of the auto firms to discuss allocation of materials, chose to ignore the OPM advisory committee already partially established, and left the impression upon Detroit's representatives that further curtailment in production may be ordered.

It is pointless to charge that these government agencies are inspired to make the auto industry a "whipping boy" in the name of defense. They have been told that the auto industry affects the livelihood of 20,000,000 people in the U. S., but from closer contact with war and rearmament, they probably possess information compelling decisions which will have strong political repercussions. Under the circumstances, Detroit expects that a new formula for curtailment will be developed, and that further unemployment will be the price paid.

To save materials is the crux of the problem, and apparently the savings foreseeable to date will be insufficient. The 20 per cent curtailment plan plus the materials substitution program will effect some remarkable reductions in consumption of critical materials in the next six months. As compared to consumption in the first six months of the 1941-model season, withdrawals of aluminum will be reduced 87 per cent, nickel steel 76 per cent, zinc 70 per cent and steel of all types 37 per cent.

How the new UAW-CIO plan can be dovetailed into the existing structure of OPM manufacturers' and labor advisory committees remains to be seen. So far as the union is concerned it evidently does not wish to subjugate its claims in Hillman's setup. The manufacturers' advisory committee had planned to set up a subcommittee that would deal with the unions, but its personnel had not been appointed. So the revised Reuther plan got a head start publicity-wise. It must be remembered that the manufacturers and labor advisory committees as now constituted are there purely to give advice. Under Justice Department rulings, decisions must be made by the government administrator to avoid conflict with the anti-trust laws.

Close Down for Model Changeover

Hudson, Nash and Lincoln discontinued 1941 model assemblies first, but practically the entire industry will close down for the model changeover either this week or next. Production has been sustained two or three weeks longer than usual in order to take advantage of the phenomenal sales situation and to make as many cars as possible before the official deadline on the season, August 1. One of the major producers of low priced cars may continue operations for two or three days into August. Total output in July is expected to be unseasonally high at around 410,000 units.

The actual time during which assembly lines are down for model changeover purposes has been successively reduced in recent years through modern developments in die manufacture and closer integration of auto production processes. Assembly lines will make a quick changeover, but the problem always remains of taking the bugs out of production, then stocking dealers. The entire process will require from five to eight weeks, depending upon maker, before new car announcements are made. Press previews of three lines will occur in late August. Most of the remaining private showings will occur in September.

WATCHING WASHINGTON

Oerliken, "anti-Stuka" gun, rates higher priority than any other project now underway. Packard begins line production of Rolls Royce aircraft engines. Civilian supplies of aluminum smallest

By BLAINE STUBBLEFIELD

WASHINGTON—The War Department's newest defense weapon, the Oerliken "anti-Stuka" gun, has been privately talked about around Washington for some weeks. It rates top priority, ahead of any other project.

AMERICAN MACHINIST has obtained information which indicates that this gun is a 20 millimeter bore, firing explosive shells at a rate approaching that of a machine gun. It is air-cooled, carries a circular magazine of something under a hundred shells. An empty magazine can be replaced instantly with a full one. Every tenth cartridge throws a "tracer" projectile (it leaves a trail of smoke) so that the operator aims as one would squirt a garden hose on a target. The gun has a special sight, whether new in principle is not known.

Apparently the advantage of the Oerliken gun is that it fires much more rapidly than any other type of explosive shell gun. The problem, in attacking dive bombers, is to concentrate rapid fire during the short period the target is exposed within effective range. The Oerliken seems to be a short range weapon of some 4,000 ft. which indicates it would not be useful against level bombing from altitude.

It is believed that this gun is of Swiss origin and that the Germans also have it. The development seems to have been assigned to the U. S. War Department by Britain, which also is putting it into production.

The major purpose of the Oerliken gun is to defend British shipping against dive bombing. Of course the Germans will use the weapon against dive bombers of the Allies, but the gun is of particular importance to the British, since Germany does not have the problem of protecting ships at sea.

Rolls Royce Engines Due Soon

Packard is scheduled to be producing Rolls Royce airplane engines about August 1. Forty a day is expected to be reached by December. Original plan to build the 1,200-hp Merlin was changed mid-way, and the engine to be produced will be the improved Rolls V-12 of about 1,600 hp. Some thought was given to building the Rolls Vulture, an X-24 of some 2,000 hp., but it was decided this would involve too much retooling and delay production excessively. Next model of the Curtiss P-40, reportedly, will be powered with a Rolls Royce engine.

Definite decision has finally been reached in the U. S. not to build Britain's other 2,000-hp. engine, the Napier Sabre, in this country either. As previously reported, this has been under consideration for several months.

Locomotive Builders Get Materials

OPACS followed its allocation program of materials to manufacturers of railroad cars June 10 with a like allocation to the makers of locomotives on July 7. The allocation covers steam, electric, and diesel engines, for railroad, mine and industrial purposes. This puts locomotive builders on a par with rail car builders. OPACS allocations aim to insure the best possible flow of supplies to civilian manufacturers of goods deemed most necessary to the public welfare.

Aluminum Civilian Demand Deferred

Civilian demand for such aluminum as is left over after all defense needs have been met is in the ratio of 15 to 1. Civilian demand for available copper is 5 to 2. For nickel the rate is 2 to 1. The ratio in steel is best of all, about 10 to 9. Practically all of the metals in general industrial use stand somewhere between aluminum and steel. Demands for all of them are going to increase. Many of the metals come from overseas; there is a shortage of cargo space to carry them; no remedy in sight. These statements were made last week by officers of OPM.

Extend Buying Pool

Use of a government buying pool to maintain maximum production, already being used in the machine tool field, would be extended to the manufacture of electric generators, steam and hydro turbines under a plan proposed to the President by the Federal Power Commission.. FPC is worried about the likelihood of a shortage of power and wants to assure the greatest possible production of generating equipment.

To do this, FPC wants to have RFC form a subsidiary corporation which would buy the full output through 1944 of manufacturers of generators and turbines. Next year orders would be placed covering 1945 deliveries. It is estimated that this program would involve placing orders amounting to $150-200,000,000 anually. As in the case of the machine tool program, this money would be a revolving fund, replenished as deliveries are made out of the pool to utilities and government public power agencies.

An important feature of the plan is that it will permit a degree of standardization of generating equipment. Moreover, sizes and numbers of units would be adjusted so that each producer can produce the maximum total kilowatts of capacity. The plan now awaits presidential approval.

AID BRAZIL STEEL OUTPUT

WASHINGTON—The U. S. has granted priority aid, and a $20,000,000 loan, to Brazil for the construction of a $45,000,000 steel plant. The preference on steel, machinery, and other equipment, will enable the National Steel Co. of Brazil to complete the mill in about three years. Balance of the $45,000,000 is being raised by the Brazilian government and private institutions. The U. S. loan of $20,000,000 is to be spent in the U. S. Priorities will not interfere with our own defense progress. Our aims in this project is to carry out the good neighbor policy, improve Brazilian living standards, expand our market there, and relieve Brazilian pressure on us for materials for its defense program. The plan was agreed to by a U. S. interdepartmental conference.

Subcontracting Not Fast Enough

Despite the admitted necessity of subcontracting defense orders, most procurement officers and armament contractors see it as an unpleasant necessity. Latest example of the reason for this attitude is the case of the power turrets for Martin bombers. Martin, for the past four years, has been a leader in the development of turrets in this country; its Navy patrol boats were the first U. S. planes to mount them. For Martin's current big production of Army bombers, turret manufacture has been subcontracted. Perhaps as a consequence, turret deliveries are at present far behind plane manufacture. Last fortnight the Army authorized Martin to go ahead and build its own turrets—$11,000,000 worth.

Repair Your Old Ones

If the government will not let you buy new cars, tractors, refrigerators, stoves, plumbing, oil burners, it will at least let you get your old ones fixed. OPACS has just set up an allocation program giving materials for such repairs the right of way.

Aircraft Regional Labor Agreements Now Underway

WASHINGTON—Regional labor stabilization agreements in the aircraft industry are now under negotiation. They represent a long step forward in OPM Director Hillman's campaign to make this form of industry-wide agreement the dominant element in wartime labor relations.

Big difference in the aircraft plan from the shipyard stabilization agreements previously worked out is that Hillman is determined to modify the labor situation in the industry rather than simply to level out conditions as was done in the shipyards. The success of the shipyard scheme in overriding opposition of Bethlehem and the San Francisco machinists has emboldened Hillman to take the further step.

Hillman's plan is to raise the relatively low wage levels of the aircraft firms up to a level comparable with that in the auto industry. Moreover, it is generally assumed that the plan will result in almost universal unionization of an industry now only about 30 per cent organized.

Wage Differential Hard to Justify

The differential between air and auto wages has become rather hard to justify now that aircraft manufacture is becoming a big scale industry, especially since the auto firms themselves are increasingly participating in plane manufacture. This differential has been a major organizing argument.

Most plane manufacturers, until quite recently, have been bitterly opposed to the plan. It won't hurt them much now, since the government will have to absorb the cost, but they are thinking of the situation after the war. However, they have been subjected to heavy pressure from Hillman.

Early this month the manufacturers met with Hillman to discuss the proposal, emerged with a formal statement that the industry will cooperate in working out regional wage agreements. It was decided to divide the country into three regions, West Coast, East Coast, and mid-West. Conferences are starting in the West; results achieved will set the pattern for the other two regions. Apparent intention is to make the regional agreement an actual contract binding on the signatories rather than, as in the shipyard agreements, merely model clauses for subsequent incorporation in bargaining agreements.

Paradoxically, most remaining opposition to the scheme come from the labor side. The situation is complicated by the number of unions, with overlapping jurisdictions, which are seeking to organize aircraft. These include the AFL machinists (operating on an industrial basis) and patternmakers, the CIO auto workers, and the independent aircraft welders. The AFL has endorsed the stabilization plan, but the CIO is cool to it.

U. S. Government Contracts Awarded to Metal-Working Firms

(Does not include contracts under $100,000)

Source	Agency	Commodity	Amount
National Tube Co., Pittsburgh, Pa.	War	Demolition bombs	$2,448,775
Harrisburg Steel Corp., Harrisburg, Pa.	"	Metal parts	1,471,180
Fedders Mfg. Co., Inc., Buffalo, N. Y.	"	Belt links	1,713,600
Remington Rand, Inc., Ilion, N. Y.	"	Fuze parts	149,850
American Locomotive Co., New York, N. Y.	"	Gun carriages	2,138,000
Schlueter Mfg. Co., St. Louis, Mo.	"	Anti tank mines	217,500
Chefford Master Mfg. Co., Inc., Fairfield, Ill.	"	Fuze parts	181,120
Charles Fischer Spring Co., Brooklyn, N. Y.	"	Rifle extractors	142,000
Miller Printing Machinery Co., Pittsburgh, Pa.	"	Parts for gun mounts	147,894
Munitions Mfg. Co., Poughkeepsie, N. Y.	"	Automatic guns	16,555,000
Bendix Aviation Corp., Elmira Heights, N. Y.	"	" "	16,283,549
A. B. Farquhar Co., Ltd., York, Pa.	"	Mortars and mounts	553,111
General Electric Co., Schenectady, N. Y.	"	Parts for howitzer	115,871
Biederman Motors Corp., Cincinnati, Ohio.	"	Truck-tractors	377,597
Blank-Buxton Machinery Co., Jackson, Mich.	NYA	Milling machines	215,388
Bradford Machine Tool Co., Cincinnati, Ohio.	"	Lathes	450,324
James W. George Machinery Co., Detroit, Mich.	"	"	135,396
South Bend Lathe Works, South Bend, Ind.	"	"	397,776
James W. George Machinery Co., Detroit, Mich.	"	Shapers, cutters and grinders	761,070
Norton Co., Worcester, Mass.	"	Cutter and grinder	144,845
Westinghouse Elec. & Mfg. Co., New York, N. Y.	War	Dynamotor unit	186,160
Hobart Brothers Co., Troy, Ohio.	"	Generating units	2,604,240
Lincoln Electric Co., Cleveland, Ohio.	NYA	Arc welder	136,500
Western Electric Co., Inc., Kearny, N. J.	War	Radio components	2,483,007
Fairchild Engine & Airplane Corp., Hagerstown, Md.	"	Two place airplanes	106,227
Titeflex Metal Hose Co., Newark, N. J.	"	Manifold assys	257,760
Hudson Motor Car Co., Detroit, Mich.	"	Fuselage	821,718
Douglas Aircraft Co., Inc., Santa Monica, Calif.	"	Airplanes	158,850,000
Consolidated Aircraft Corp., San Diego, Calif., and Ford Motor Co., Dearborn, Mich.	"	"	163,640,000
Diamond T Motor Car Co., Chicago, Ill.	"	Trucks	5,746,949
White Motor Co., Cleveland, Ohio.	"	"	3,522,310
Bendix Aviation Corp., Scintilla Magneto Div., Sidney, N. Y.	"	Manifold assys	126,000
Trailer Co. of America, Cincinnati, Ohio.	"	Trailers	418,650
Mack Mfg. Corp., Long Island City, N. Y.	"	Engines	149,386
Standard Forgings Corp., Indiana Harbor, Ind.	"	Shell forgings	561,600
Tredegar Co., Richmond, Va.	"	Shells	200,837
Mackintosh-Hemphill Co., Pittsburgh, Pa.	"	Steel castings	180,618
Walter Kidde & Co., Inc., New York, N. Y.	"	Oxygen cylinder	115,102
Crosby Co., Buffalo, N. Y.	"	Magazines	420,000
J. H. Williams & Co., Buffalo, N. Y.	"	Socket wrenches	422,794
Snap-On Tools Corp., Kenosha, Wis.	"	" "	366,573
Read Machinery Co., Inc., York, Pa.	"	Parts for mortar	127,050
Wheland Co., Chattanooga, Tenn.	"	Guns	2,282,800
Continental Motors Corp., Muskegon, Mich.	"	Tank parts	1,220,147
Guiberson Diesel Engine Co., Chicago, Ill.	"	" "	3,390,072
Indian Motorcycle Co., Springfield, Mass.	"	Motorcycles	2,079,055
Studebaker Corp., South Bend, Ind.	"	Trucks	11,654,790
General Motors Corp., (Chev. Div.), Detroit, Mich.	"	"	5,072,935
Fargo Motor Corp., Detroit, Mich.	"	"	11,536,975
New Process Gear Corp., Syracuse, N. Y.	"	Traversing mechanism for tanks	102,948
James Cunningham Son & Co., Rochester, N. Y.	"	Carriage assys	124,087
Yellow Truck & Coach Mfg. Co., York, Pa.	"	Trucks	678,480
International Register Co., Chicago, Ill.	"	Shells	1,593,700
Pullman Standard Car Co., Butler, Pa.	"	Shells	4,650,000
Western Cartridge Co., East Alton, Ill.	"	Cartridges	2,526,700
Smith and Wesson, Inc., Springfield, Mass.	"	Revolvers	1,170,444
Bendix Aviation Corp., Bendix Marine Div., Brooklyn, N. Y.	"	Differentials	908,976
Chicago Flexible Shaft Co., Chicago, Ill.	"	Fuzes	901,529
Defiance Pressed Steel Co., Marion, Ohio.	"	Cartridges	1,291,408
Remington Arms Co., Inc., Bridgeport, Conn.	"	"	2,460,000
Lamson Co., Inc., Syracuse, N. Y.	"	Tripod mounts	1,243,152
Mesta Machine Co., West Homestead, Pa.	"	Guns	1,863,140
Bowen Products Corp., Ecorse, Mich.	"	Cartridge cases	1,075,000
Ryerson & Haynes, Inc., Jackson, Mich.	"	" "	716,000
Pullman Standard Car Mfg. Co., Hammond, Ind.	"	Gun carriages	1,548,000
General Motors Corp., Delco Appliance Div., Rochester, N. Y.	"	Gun directors	524,000
Colt's Patent Fire Arms Mfg. Co., Hartford, Conn.	"	Guns	6,663,482
High Standard Mfg. Co., New Haven, Conn.	"	"	4,734,841
American Locomotive Co., Schenectady, N. Y.	"	Tanks	26,725,000
Borg-Warner Corp., Mechanics Universal Joint Div., Rockford, Ill.	"	Fuzes	1,586,000
U. S. L. Battery Corp., Metal Mfg. Div., Long Island City, N. Y.	"	Projectiles	550,000
Budd, Edward G. Mfg. Co., Philadelphia, Pa.	"	Shells	870,000
Fort Pitt Bedding Co., Pittsburgh, Pa.	"	Links	720,000
United Engineering & Foundry Co., Pittsburgh, Pa.	"	Guns	1,220,199
Autocar Co., Ardmore, Pa.	"	Tractor-trucks	5,056,283
White Motor Co., Cleveland, Ohio.	"	Trucks	1,957,800
Fargo Motor Corp., Detroit, Mich.	"	"	11,236,975
Yellow Truck & Coach Mfg. Co., Pontiac, Mich.	"	"	45,594,774
Newburgh Wire Works, Cleveland, Ohio.	"	Steel, manganese, molybdenum	156,679
Colt's Patent Fire Arms Mfg. Co., Hartford, Conn.	"	Small arms material	102,803
Republic Drill & Tool Co., Chicago, Ill.	"	Twist drill	299,942
Nicholson File Co., Providence, R. I.	"	Files	124,509
The Tredegar Co., Richmond, Va.	"	Shell	175,536
Baldwin Locomotive Works, Philadelphia, Pa.	"	Steel castings	205,104
Kilby Steel Co., Anniston, Ala.	"	Shell	803,000
Reynolds Metals Co., Louisville, Ky.	"	Aluminum alloy sheets	292,856
The Bullard Co., Bridgeport, Conn.	"	Lathes	4,391,440
High Standard Mfg. Co., Inc., New Haven, Conn.	"	Machine guns	4,870,817
Niles Tool Works Div., General Machinery Corp., Hamilton, Ohio.	"	Lathes	371,120
R. K. LeBlond Machine Tool Co., Cincinnati, Ohio	"	Lathes	486,505
Continental Electric Co., Inc., Newark, N. J.	"	Power plants	154,998
Sperry Gyroscope Co., Inc., Brooklyn, N. Y.	"	Searchlight	5,464,450
White Motor Co., Cleveland, Ohio.	"	Trucks	238,150

Heads Edward Valve

WILLIAM F. CRAWFORD

Holophane Works Mgr.

HOWARD J. TAIT

Advanced by Amer. Car

F. A. STEVENSON

Joins Machinery Inst.

GEORGE TERBORGH

NAMES in the NEWS

J. C. Augsburger, former assistant manager, Gary, Ind. plant, American Bridge Co., U. S. Steel Corp. subsidiary, has been appointed assistant to the vice-president in charge of manufacturing operations. He succeeds B. O. Bateman who is retiring after more than 39 years. A. J. Paddock, formerly manager, Elmira, N. Y. plant, has been named manager, Gary, Ind. plant, following the retirement of P. W. Seyl. R. C. Robinson, assistant manager, Elmira plant, becomes manager, and G. K. Manzer, former assistant rate foreman, Gary plant, has been transferred to Elmira as assistant manager. H. B. Hill, former plant engineer, Shiffler, Pa., plant, has been named manager to succeed J. M. Martin who is retiring after more than 41 years of service.

Wm. F. Crawford, vice-president since 1937, the Edward Valve & Mfg. Co. Inc., East Chicago, Ind., has been elected president.

Samuel Dunlap has retired as auditor and director, American Steel & Wire Co., subsidiary U. S. Steel Corp., after 46 years of service.

Paul Fielden has been named director of purchases, Norton Co., Worcester, Mass.

Henry M. Hogan and Frederic G. Donner have been elected vice-presidents, General Motors Co.

Edward J. McCann, formerly superintendent, has been appointed general works manager, South Chester Tube Co., South Chester, Pa.

R. J. Minshall, formerly vice-president and director, the Boeing Aircraft Co., has resigned to become president, the Pump Engineering Service Corp., Cleveland, Ohio. He had been affiliated with the Boeing Co. in an engineering capacity since 1918, having served as design engineer, chief engineer and finally vice-president.

Harry Merritt has resigned as vice-president and manager of the tractor department, Allis-Chalmers Mfg. Co., Milwaukee, Wis. He will continue in an advisory capacity.

Leo T. Neidow and L. Bruce Grannis have been elected vice-presidents in charge of production and sales respectively, Anker-Holth Mfg. Co., Port Huron, Mich.

CHARLES A. SIMMONS, JR.

Charles A. Simmons, Jr., only 25 years old, has been elected vice-president and general manager, the Simmons Machine Tool Corp., Albany, N. Y. One of the youngest executives among major machine tool firms, he began work at the age of 16 in his father's shop. Mr. Simmons, Sr., president, is a member of the tool section, OPM, and during his absence his son has been directing the operations of the company.

C. W. Pearsall has been named general sales manager, Ahlberg Bearing Co., Chicago.

Frank R. Pierce has been appointed to the newly created post of vice-president in charge of sales, the Nash-Kelvinator Corp.

G. R. Prout, manager of sales since 1939, has been appointed manager, Industrial Control Div., General Electric Co. R. S. Glenn has been appointed manager of sales to assist Prout. E. H. Alexander has been named engineer, Industrial Control Div.

F. A. Stevenson has been elected senior vice-president, American Car & Foundry Co., New York, N. Y. He will continue in charge of operations. W. L. Stancliffe, formerly manager of miscellaneous sales, has been elected vice-president.

M. J. Tennes, Jr., president, Shafer Bearing Corp., Chicago, has entered active service with the U. S. Army Air Corps.

George Terborgh, formerly senior economist, Board of Governors of the Federal Reserve Bank, Washington, D. C., has been elected secretary, Machinery and Allied Products Institute, 221 North La Salle St., Chicago, Ill.

Howard J. Tait has been appointed works manager, Holophane Co. Inc., Newark, Ohio.

Arch Warner has been named assistant works manager, Mechanics Universal Joint Div., Borg-Warner Corp., Rockford, Ill.

Henry Wilder, Heald Machine Co., Worcester, Mass., has been named regional chairman for the Worcester district of the emergency defense training committee, American Society of Tool Engineers.

Sidney D. Williams, vice-president in

charge of steel sales, Copperweld Steel Co., Glassport, Pa., has been named executive vice-president in charge of the company's new steel division at Warren, Ohio.

PLANT EXPANSION

Air Associates, Inc., Bendix, N. J. has begun the construction of an addition to its manufacturing plant. The new building, which will comprise approximately 70,000 sq. ft. on one floor, will cost approximately $300,000 and is expected to be completed by Oct. 15.

Ampco Metal, Inc., Milwaukee, Wis. is erecting a new foundry addition to its plant.

Anderson and Carlson, Los Angeles, Calif., will construct a new machine shop at a cost of $9,000.

Carnegie-Illinois Steel Corp., Pittsburgh, has acquired the tin-plate manufacturing plant of Standard Tin Plate Co., subsidiary of Continental Can Co.

De Soto Div., Chrysler Corp., has begun construction work on a new 63,000 sq.ft. plant for the manufacture of parts for the 40-mm. rapid-firing anti-aircraft gun.

General Metals Corp., Los Angeles, Calif., will construct a new factory building at a cost of $2,500.

The Hafer Machine Co., Ltd., Vancouver, B. C., will build a $7,000 extension to its machine shop.

The Herman Nelson Corp., Moline, Ill., has acquired the assets and business of the Autovent Fan and Blower Co., Chicago.

International Business Machines Corp., New York, N. Y. has added a new factory building to its existing plant at Endicott, N. Y.

Light Metals, Inc., Indianapolis, Ind., has completed a new magnesium foundry to produce approximately 20,000 lbs. of finished magnesium castings per month.

Sampson Motors, Los Angeles, Calif., will construct a new machine shop at a cost of $11,500.

Utility Fan Corp., Los Angeles, Calif., will erect a new factory building at a cost of $15,000.

BUSINESS ITEMS

Donberg and Danits, Chicago, a new concern dealing in used equipment, has been formed by Joseph H. Donberg and Samuel Danits, formerly of Louis Emmerman & Co.

David Hoppenstand, president, Hopkan Rivet Co., Pittsburgh, has organized Latham Machine Co., Pittsburgh, to manufacture gages and various types of hobs, cutters and machine tools.

Kimble Motors, Inc., Los Angeles, Calif., has been organized recently with L. Talbott, E. Jay and A. Bastian as directors.

D. R. Laughter, former sales engineering manager, Sheffield Gage Co., is head of a new company which will manufacture tools designed by Production Products.

Pixweve Aviation Corp., Los Angeles, Calif., has been organized with a capital of $25,000.

OBITUARIES

FREDERIC J. FISHER

Frederic J. Fisher, 63, eldest of the seven "Body by Fisher" brothers, and a retired official of General Motors, died last week in Detroit. As titular head of the family of seven brothers and three sisters, he led them in the rise from the relative obscurity of an Ohio blacksmith shop to command a $500,000,000 fortune. By the time he was 25, Fred Fisher was an expert carriage maker. In 1902 he went to Detroit where he found work with the Wilson Carriage Works. Soon all the Fisher brothers followed. The Fisher Body Co. was organized by Andrew Fisher, an uncle of the brothers, as president. On a $50,000 loan the brothers bought out their uncle's interest and in two decades they sold the business to General Motors for $208,000,000, a fabulous profit.

Gail Bacheller, Woodall Industries, Detroit, died recently in that city. In 1885 he went into the tool and die business at Big Rapids, Mich. Later he was employed by Buick and Studebaker.

Fred N. Brauer, chief of ordnance, Watertown Arsenal, nationally known expert on steels and alloys, died at a Brookline, Mass. hospital recently. Although he was on inactive status for the past 12 years due to personal injuries, he was often called for ordnance problems consultations.

Wm. G. Cram, 43, service engineer, Kearney & Trecker Corp., Milwaukee, Wis., died of a heart attack on June 21.

Leslie C. Jacobson, 51, superintendent in charge of fabrication departments, Carboloy Co. Inc., died June 24.

Otto V. Kruse, 54, general sales manager, the Baldwin Locomotive Works, Philadelphia, Pa., died on July 2. Active in the hydroelectric industry, he became associated with the Wm. Cramp & Sons Ship & Engine Building Co., as consulting engineer. In 1931 the Baldwin Locomotive Works acquired this business and in 1939 he was made general sales manager of the Baldwin Locomotive Works, a position which he held at the time of his death.

Thomas B. Morton, 81, president, Armored Car Corp., Louisville, Ky., died on June 30.

Frank Edward Rice, vice-president, American Tap Brush Co., died recently. He had been associated with the company for 40 years. He was also vice-president and factory manager, Kay Salt Co., and consulting engineer of the old Gearless Differential Co.

MEETINGS

American Mining Congress. Eighth Annual Metal Mining Convention and Exposition. San Francisco, Calif., September 29-October 2.

American Society for Metals. Twenty-third National Metal Congress and Exposition. Convention Hall and Commercial Museum, Philadelphia, Pa., Oct. 20-24.

American Society of Mechanical Engineers. Fall meeting. Louisville, Ky., Oct. 12-15.

American Society of Tool Engineers. Semi-annual meeting. Royal York Hotel, Toronto, Canada, Oct. 16-18.

American Welding Society. Annual Meeting and Convention. Bellevue Stratford Hotel, Philadelphia, Pa., Oct. 19-24.

Exposition of Power and Mechanical Engineering. International Amphitheater, Chicago, Ill., Oct. 6-11.

Society of Automotive Engineers. National Tractor meeting. Schroeder Hotel, Milwaukee, Wis., Sept. 25-26.

Society of Automotive Engineers. National Aircraft Production meeting. Biltmore Hotel, Los Angeles, Calif., Oct. 30-Nov. 1.

SHOP EQUIPMENT NEWS

Gleason Automatic Surface Hardening Machine Handles Gears and Sprockets

Advantages of oxy-acetylene flame hardening are extended to medium and small-size bevel, spur and internal gears, sprockets and the like, with the announcement of a new automatic surface hardening machine by the Gleason Works, 1000 University Ave., Rochester, N. Y. With this machine, both sides of the tooth are hardened simultaneously without distortion. Each tooth is hardened in exactly the same length of time and to the same depth as every other tooth. The machine has a capacity for bevel gears up to 33 in. pitch diameter.

The machine consists of a base, a work holding unit, and a column on which is mounted the burner slide. The burner column is stationary on the base, the work head being adjustable to and away from the burner column to accommodate various sizes and types of gears. Coolant tank, coolant pump, cooling unit, hydraulic oil reservoir, hydraulic pump, and pump motor and controls are located in the base.

Burner arms are mounted on a slide which in turn is mounted on a swivel base attached to the upper part of the burner column. This is the mechanism which imparts to the machine the motion required for operation. Work head swings in trunnions and can be adjusted to any desired angle. Movement of the work head towards and away from the burner column is accomplished by means of rack and pinion. Change gears are provided for indexing any number of teeth from 5 to 100.

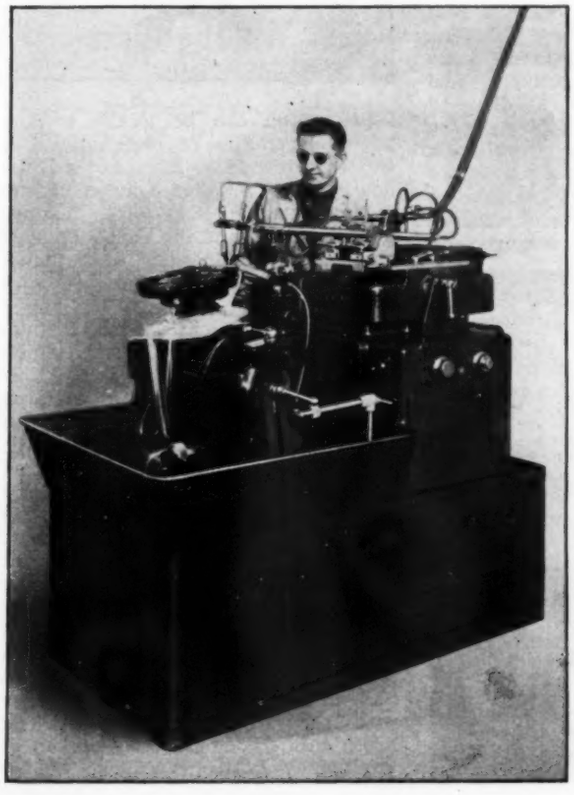
A change gear actuated roll motion of the work head causes the burners to follow the curved teeth on spiral bevel and helical gears. A variable rate of travel of the burner slide is provided to give a progressively increasing or decreasing velocity to compensate for the continuous change in tooth section in a bevel gear, for the heat accumulation ahead of the burners, and to give a speed-up over the ends of the teeth at the termination of the hardening stroke. Operation of the machine is entirely automatic. The machine will index, roll, preheat and harden the teeth, stop the motor and shut off the gas when all of the teeth are hardened.

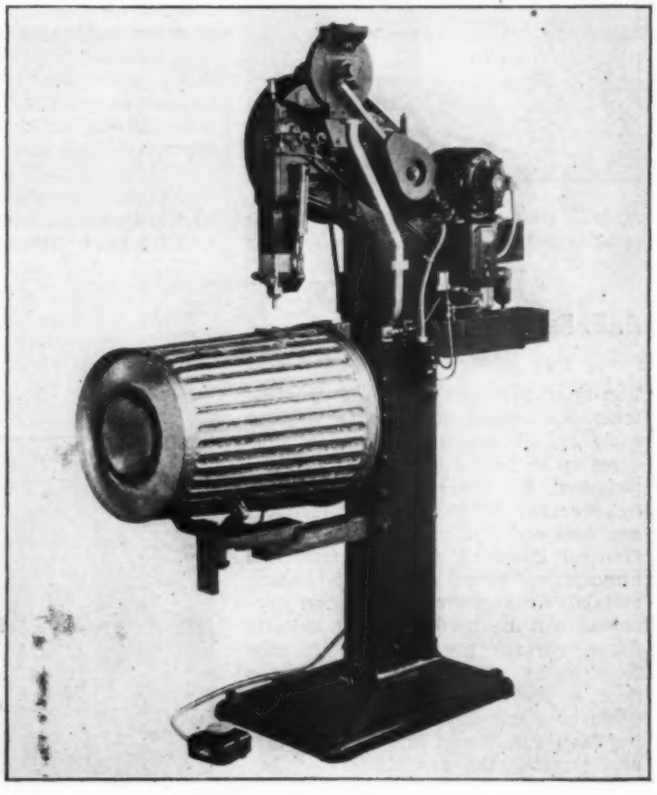
Tomkins-Johnson "Rivitor" Feeds Rivets, Pierces, and Rivets

On the "RK" Rivet-Pierce Rivitor, just announced by the Tompkins-Johnson Co., 617 North Mechanic St., Jackson, Mich., the previously unpierced work is driven down over the automatically underfed rivet, punching a slug out of the work. The rivet is then "set" at the next stroke of the machine. A light spot directs a beam of light on the top of the work to indicate the exact position of the rivet underneath.

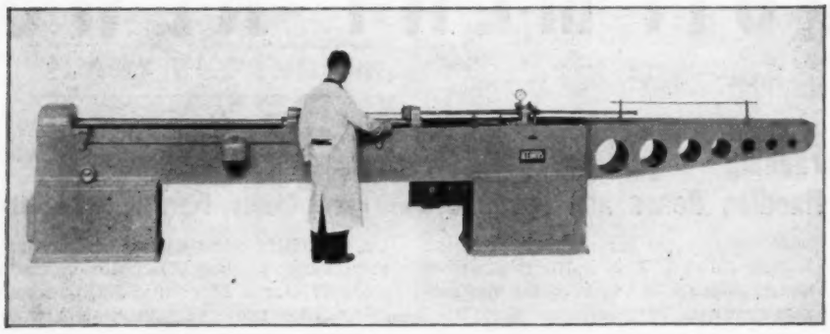
When the slug is punched out of the work by the unannealed rivet, the slug escapes through a hole in the front of the head which then reverses through 90 deg. on the upstroke to bring the riveting head into position. Work remains in the same position for the piercing and the riveting. Production is determined largely by speed with which work can be handled; flywheel speed is 190 strokes per min.

Solid unannealed steel rivets of the "coopers," "tinners," or flat-head type up to 0.140 in. diam. can be handled. Maximum total work thickness of 0.075 in. for this size rivet. Throat depth is 8, 12, or 14 in. Ram stroke is 3 in.





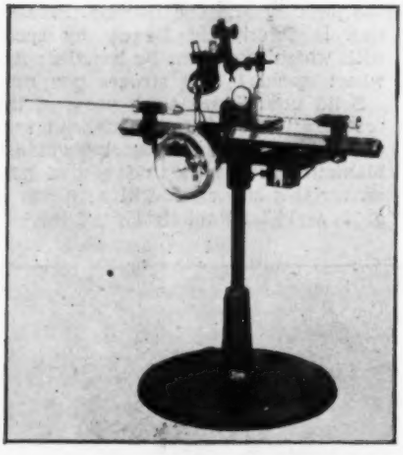
Broaching System for Rifling Gun Barrels Developed by Illinois Tool Works



Broaches of this Illinois rifle broaching machine produce their own lead

Speed and accuracy of the broaching method has been brought to the rifling of machine gun and rifle barrels in a new broaching system developed by the Illinois Tool Works, 2501 N. Keeler Ave., Chicago, Ill. Elements of the system include broaches, broaching machines, broach sharpening machines and broach inspection fixtures.

The Illinois Broaching Machine for rifling gun barrels is a screw type machine. Screw is driven through V-belts by a reversible motor. Free floating, ball-bearing, jaw-type puller contains a safety link which protects the broach against breakage. The broaches are pulled through the barrel and produce their own lead. No other device for turning other than a freely rotating puller is required. The ability of the broaches to follow their own lead is created by the sides of the broach teeth and by helical chip breakers in each tooth. Cutting lubricant is supplied under high pressure which forces the lubricant around the broach and through the barrel. Besides acting as a lubricant and coolant, the oil removes the chips from the cutting edges and accumulates them at the back of the preceding tooth.



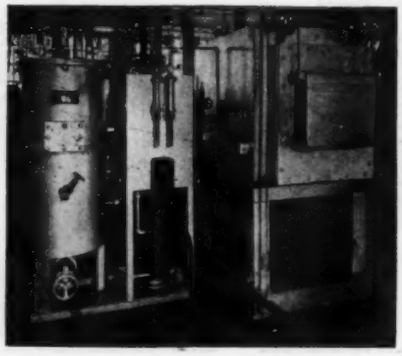
Broach inspection fixture swivels to convenient angle for visual checking

Principle of the rifling broach sharpening machine is similar to that of other broach sharpening machines. They are equipped with special steady rests, interchangeable, grinding and polishing spindles and a diamond wheel dressing device. The rifling broach inspection fixture provides for visual inspection through a microscope of 20X magnification. Sizes and steps of the broached teeth are checked by a snap-gage indicator arrangement.

G. E. Box-Type Furnace Heat-Treats Small Parts

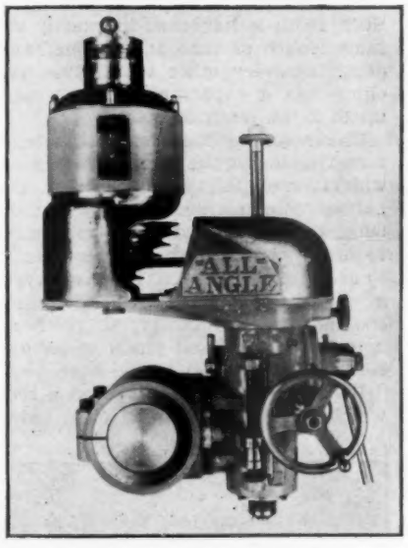
Box-type furnaces for heat-treating tools and small steel parts without scale or decarburization at temperatures up to 2,000 deg. F. have been announced by General Electric Co., Schenectady, N. Y. The new furnaces are designed for use with drycolene, General Electric's recently announced atmosphere gas for heat-treating metals. Atmospheres other than drycolene can be used. A high velocity flame curtain prevents the furnace from losing its atmosphere when the door is open. Flame curtain is shot down over the door opening, eliminating the possibility of dirt dropping into and clogging the gas burner.

There are four furnaces in the new box-type line, the largest of which has a motor-operated door. Each furnace consists of a light-weight refractory lining backed by heat-insulated material, all inclosed in a welded, gas-tight, sheet-steel casing. Furnace Type 1227 has an internal width of 12 in., a working length of 27 in., and a door height of 8 in. The corresponding dimensions of Type 1530 are 15 in., 30 in., and 10 in.; of Type 1836, 18 in., 36 in., and 13 in. Type 2754 has an internal width of 27 in., a working length of 54 in., and a door height of 20 in.



Motor Swings Around Housing Of Fray Milling Attachment

The "All-Angle" full-universal milling attachment now being placed on the market by Fray Machine Tool Co., 515 W. Windsor Rd., Glendale, Calif., is equipped with a ball-bearing motor which swings completely around the

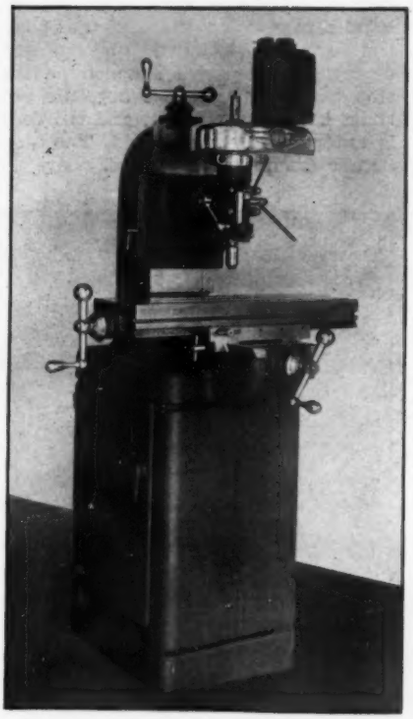


housing and can be locked at any point. Housing is of Meehanite with two squaring faces machined on the housing for convenience in setting attachment square with table. Castings are normalized and the bore is finished by grinding. Graduations on the housing are in sixteenths for use with depth stop.

Spindle is of chrome-molybdenum steel, S.A.E. 4140, with six splines. Means have been provided so that collets can be tightened either by hand or by wrench. Spindles are fitted with radial thrust ball bearings. Spindle travel is 3½ in.; spindle is furnished with No. 7 Brown & Sharpe or No. 2 Morse taper. Six-step pulleys provide a speed range from 375 to 5,200 r.p.m.

Quill is hardened and ground all over. Means have been provided so that the attachment can be instantly changed from micrometer wheel feed to hand lever feed or vice versa. The screw of the micrometer depth stop has ground threads. Nuts are large with easily read graduations. The depth stop can be positively locked at any point.

All Control Levers Conveniently Placed In Holland High Speed Vertical Milling Machine



High spindle speeds and rigid construction of the new Holland vertical milling machine distributed by Marburg Brothers, Inc., 90 West St., New York, N. Y., assure smooth finish and accurate work on tools, dies, molds and accurate production jobs. Since the operator usually sits while doing this fine work, the table of this machine is at a fixed height, and all table screws are within convenient reach for use simultaneously.

Column is a full box construction and cast solid with the knee to eliminate vibration. Head is mounted on the vertical slide, the bearings of which are up out of the way from chips and dust. The three slides, vertical, table and cross, are provided with wide hand scraped ways and with heavy adjustable gibs.

The high speed head is a self-contained, motor driven unit. Graduated 90 deg. both ways, it can be turned to any angle parallel with the longitudinal feed. The quill is lever feed with depth stop graduated in thousandths. Spindle is of alloy steel, heat treated and splined at the upper end for the pulley. The lower end is machined for No. 7 Brown & Sharpe taper. Quill is chromium plated.

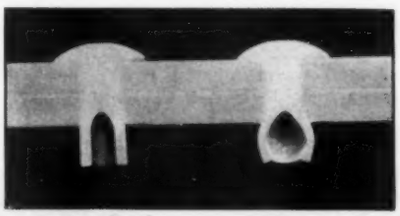
Longitudinal hand feed is 16 in.; cross feed is 8 in., and vertical feed is 8 in. Distance from spindle to table is 11 in. There are seven spindle speeds ranging from 525 to 4,000 r.p.m. Collet capacity is ½ in., and quill travel is 3 in. Distance from spindle to column is 8¾ in.

DuPont Explosive Rivets Speed "Blind" Riveting

Now being manufactured in commercial quantities by E. I. du Pont de Nemours & Co., Wilmington, Del., a new type of explosive rivet has a high explosive charge secreted in a cavity at the end of the shank. Heat applied to the rivet head by an electric "gun" detonates the charge. The explosion expands the charged end of the shank, thus forming a "blind" head and setting the rivet. The whole operation is performed from one side with greater ease and speed than is possible by any mechanical means now being used in aircraft factories.

The new du Pont rivets can be headed by one workman at a rate of 15 to 20 rivets a minute, once they are inserted in the holes. The riveting gun or iron weighs less than 5 lb. The rivets themselves only weigh about ¼ as much as generally used "blind" fasteners of mechanical design. So finely has the explosive charge been controlled, that the expansion it effects may be held within limits of 0.020 in.

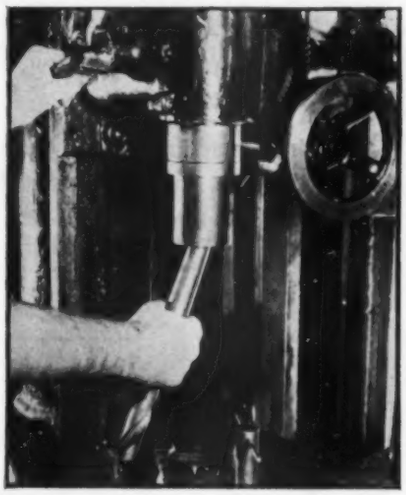
The rivets now being manufactured are of an aluminum alloy. Of varying diameters and sizes to meet structural



requirements, they are of the modified brazier head and countersunk type, the latter permitting flush riveting. Rivets are installed in the age hardened condition and do not require refrigeration after heat-treatment. In shear and tension these rivets develop values which are approximately the equivalent of driven rivets. The rivets are anodized to prevent corrosion.

Advance Automatic Drill Remover Eliminates Drift or Key

Disadvantages of the usual method of removing drills from drill spindles by means of a drift or key have been eliminated by the new attachment of the Advance Machine Works, 3727 Weisser Park Ave., Fort Wayne, Ind. The device is quickly and easily attached to the drill spindle. The drill is removed by feeding the spindle up so that the top of the remover contacts the spindle housing. This compresses

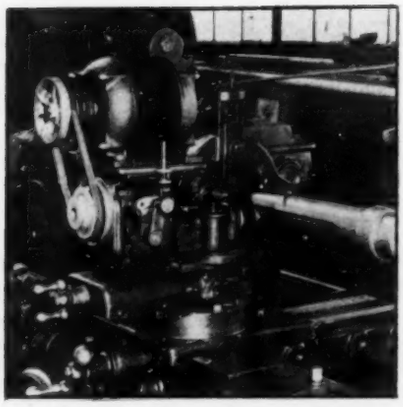


springs in the attachment and results in the extraction of the drill. The operator has a free hand with which to grasp the drill, hence eliminating breakage of drill points which results from drills falling to the table when knocked out with a drift.

Hanna Milling Attachment Fits 16-In. and Larger Lathes

Key seats, slots, splines, and similar jobs can be cut on any work that will go into a lathe with this Marvel milling attachment No. 2, manufactured by Michael Hanna, Glen Rogers, W. Va. The vertical attachment gives an adjustment of 4 in. for die and tool work. Operator has the same control of the end mill that he has of a turning tool. The machine can be fitted to any lathe with 16-in. swing or over within an hour, and afterwards can be installed within 3 min.

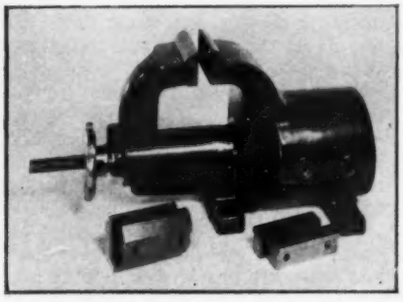
A standard V-belt drive through three-step cone pulley gives three speeds; with the gear shift changing machine, six speeds ranging from 255 to 1,056 r.p.m. are provided. Either cutters or drills can be used on these



machines. Tool will drive a ⅝ in. end mill in 0.40 carbon steel at the rate of 1 in. per min. The work does not have to be removed from the lathe, and can be held either between centers or in a chuck. A steady rest is placed at a convenient point to prevent turning or springing. Key seats can often be done with this attachment in less time than it takes to transfer work to a milling machine.

Fastmatic Production Vise Is Cylinder-Operated

Smooth and rapid jaw traverse of a new quantity production vise manufactured by Fastmatic Vise Co., 120 Boylston St., Boston, Mass., is obtained by an oil or air operated piston which is directly connected to the sliding jaw member. Holding power between the fixed and movable jaw is regulated by the pressure in the piston. Air pressure at 80 to 100 lb. per sq. in. is usually supplied from shop air supply lines.



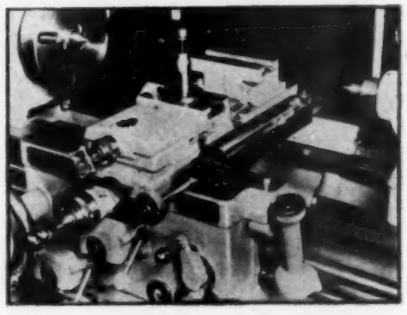
Oil pressure is supplied from pumps on the individual machines or from independent hydraulic pumps.

The movement of the piston in its cylinder is approximately 1 in. Various sizes of work are accommodated by setting the jaw to the spacing desired by an adjusting screw located on the front end of the vise. The 1-in. movement of the jaw is all that is required to release and clamp the work. Jaw operation is controlled by a conveniently located valve which may be either hand or foot-operated. Available with a variety of hardened, soft or formed jaws and in a number of sizes.

Automatic Length, Adjustable Cross Stops Features of Reed-Prentice Lathes

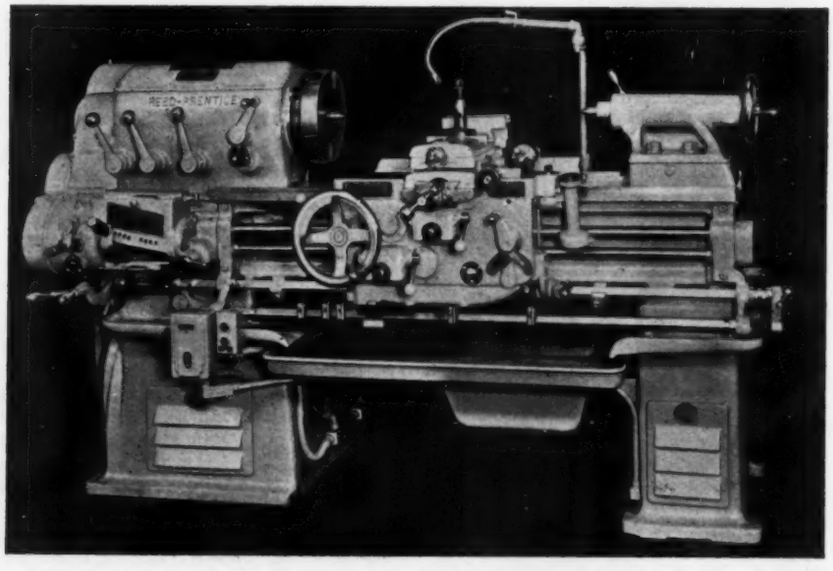
Lathes manufactured by Reed-Prentice Corp., Worcester, Ohio, now feature automatic multiple length stops for accurately duplicating shoulder lengths on repetition work, and adjustable multiple cross stops for accurately duplicating diameters on repetition work. The machines are also being furnished when desired with front and rear tool blocks, for which there is an increasing demand in many industries.

In the automatic multiple length stops, a sliding bar mounted at the front of the lathe is coupled to the clutch shifter rod, and carries a number of adjustable stop dogs. A stop handle carried on the apron engages the dogs in turn, moving the bar and disengaging the feed. A touch on the stop handle releases the dog, the rod slides back into position, and the feed is automatically re-engaged. The stop handle then rides forward ready to contact the succeeding stop dog for the next shoulder length.



Close-up view of Reed-Prentice lathe shows the details of adjustable multiple cross stops. Chip guard is shown in phantom

The adjustable multiple cross stops consist of a rod mounted in brackets across the carriage wings, and carrying a stop block in which there are six adjustable stops. The stop block slides on the cross rod on which it is securely clamped in position. Stops are adjustable for the series of diameters required and can be rotated by means of the knurled knob at the front into position for contacting the hardened stop dog attached to the compound rest cross slide. After rotation the rod is retained in position by a spring plunger.

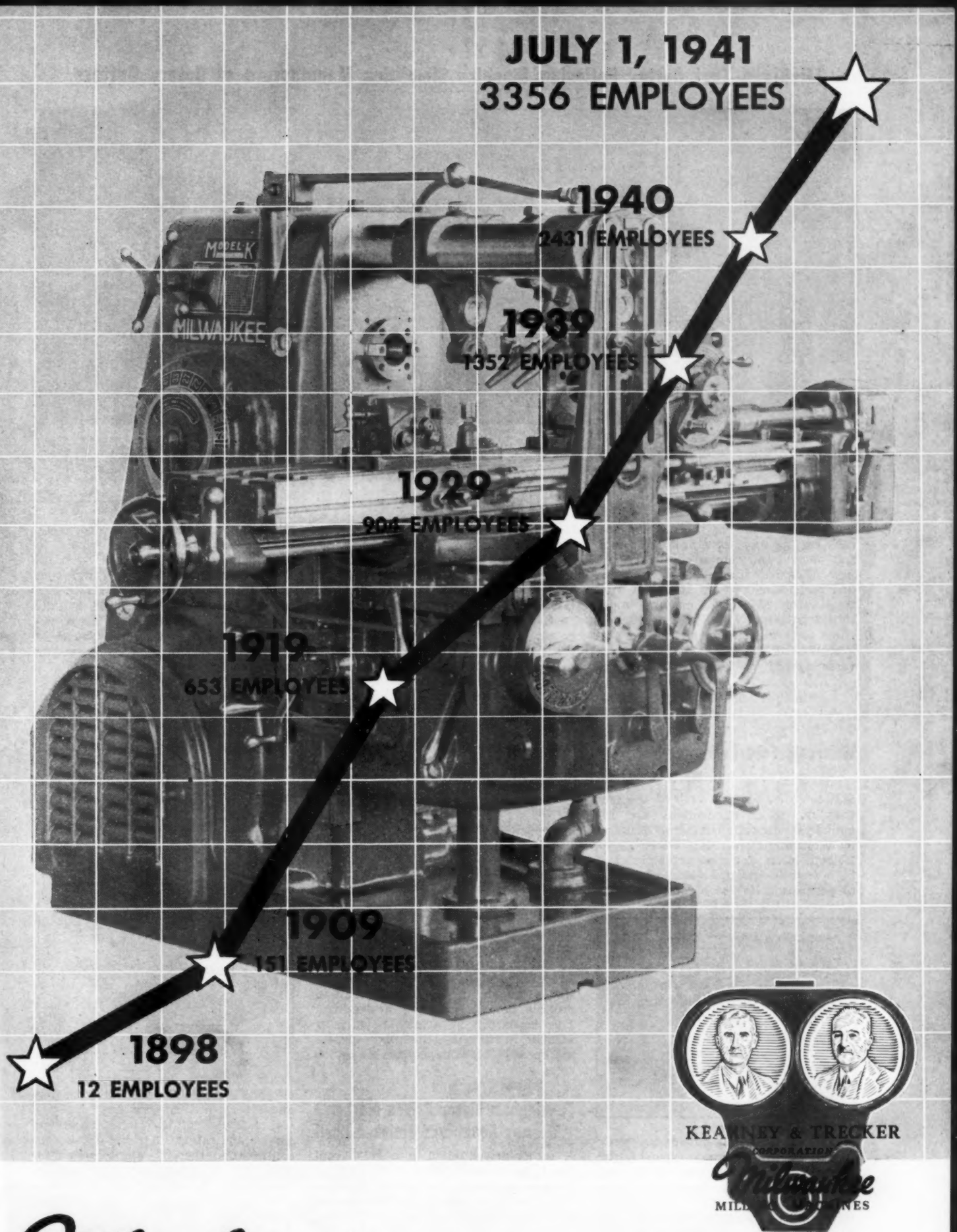


General view of 14-in. Model AA engine lathe equipped with automatic multiple length stops and adjustable multiple cross stops

Goodrich Hose Bends to 3-In. Radius Without Cutting Supply

A new lightweight air hose so flexible that the ½-in. size can be bent to a 3-in. radius without collapsing or cutting off the air supply has been developed by B. F. Goodrich Co., Akron, Ohio. Strength and efficiency of the hose are combined with minimum weight and ease of handling.

Compound of the tube is oil resistant rubber, with excellent heat-resisting characteristics. The tube does not flake or clog tools. Yarn reinforcement affords a safety factor of more than five under a working pressure of 125 lb. per sq. in. Golden ply insulation has been especially developed to assist flexibility and resistance to kinking. Made in a light gray which stands out prominently and is easy for operators of shop trucks to see. Stocked in ½ and ¾-in. sizes. Of two-braid construction, the hose can withstand pressure from 80 to 125 lb. per sq. in.



KEARNEY & TRECKER CORPORATION

Milwaukee

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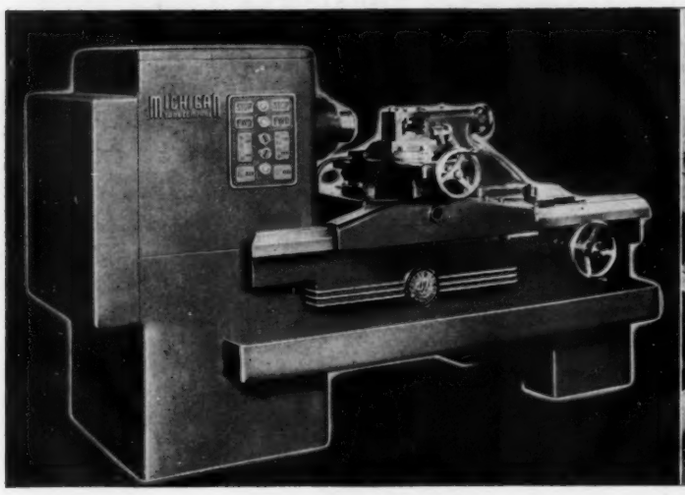
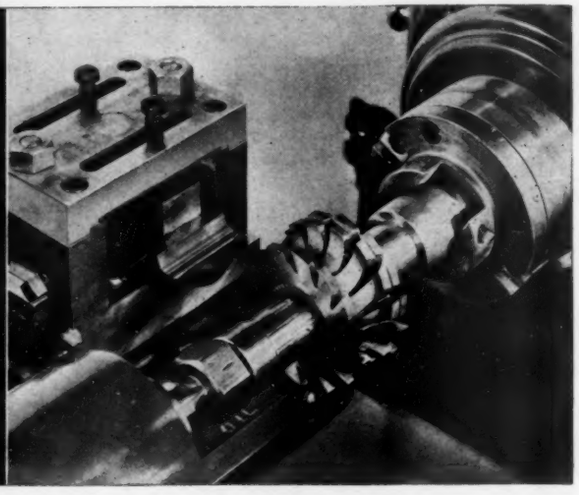
Milwaukee MILLING MACHINES

The Largest Plant In The World Devoted Exclusively
To The Manufacture Of Milling Machines

Michigan Tool Cutter Relieving Machine Simplifies Manufacture of Rotary Cutters



Gear and rack cutting tools, form tools, and milling cutters, spot facers and similar rotary tools can be relieved on this new Michigan machine



The new Michigan 1708-A universal cutter relieving machine is set up in this manner for relieving a special form cutter

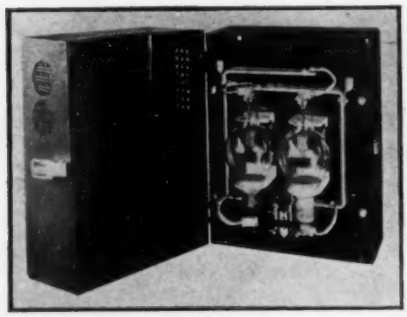
Suitable for relieving form, gear and rack cutting tools, and milling cutters, spot facers, and similar rotary tools, a new universal cutter relieving machine has been developed by Michigan Tool Co., Detroit, Mich. The machine is designed to simplify the manufacture of these tools in defense production.

Multiple range of forward and reverse speeds to handle virtually all forms of work at maximum efficiency; turntable for cam slide permitting relieving from any angle; universal adjustable tool box for quick set-up; quick-interchangeable cams; lubrication from reservoirs with inspection portholes—all are features of the machine.

It will handle work up to 8 in. in diam., with maximum length between centers of 24 in. Number of teeth that can be relieved ranges from 1 to 24. Maximum relieving stroke is ¾ in. Two reversible motors are coupled in such a manner that by operating either one or both motors, seven spindle speeds—four forward and three reverse—are available at the touch of an electrical control while the machine is running.

Weltronic Tube Contactor Simple to Install

Simple to install by virtue of the fact that no water connections are required, a new tube contactor designed by Weltronic Corp., East Outer Drive, Detroit, Mich., for spot, projection and butt welders, has the added advantage of permitting its use on small welding



equipment previously outside the range of capacity of electronic types of contactors. The new "Stat-o-Tron" contactor requires only four simple electrical connections—one to the primary circuit of the welding equipment, one to the power line, and two to the timer or foot switch. The contactor can be used with loads as small as 5 kva.

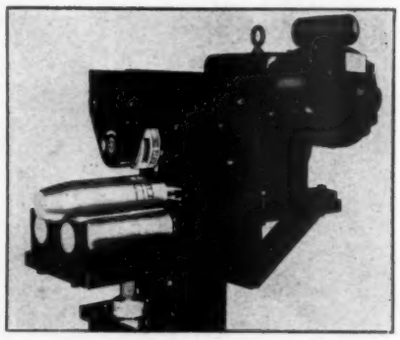
The new contactor contains two air-cooled Stat-o-Tron tubes arranged in such a manner as to perform the same function as a magnetic contactor. When the door to the contactor is open, a glance reveals whether or not the tubes are firing, since the tubes are of glass. A metal guard around the tubes prevents accidental shock.

Firing in the new power tube is accomplished by means of a static charge, obtained from a band around the outside of the tube, creating a cathode spot within the tube. Firing is consistent and positive and requires no adjustment of the contactor. A thermostat is provided in the anode circuit to prevent damage in case of overload. The contactor is available with or without firing relay, the relay operating on any coil voltage from 24 to 550 volts.

Cunningham Motor Driven Marker Stamps Rough and Finished Shell

A motor-driven shell marker, Model No. 1, for marking around the circumference of rough forged or finished shell has been placed on the market by M. E. Cunningham Co., 115-117 East Carson St., Pittsburgh, Pa. The machine is made in either pedestal or bench models and can be easily installed into any inspection or production line because of small compact size. Steel plate construction is solid and sturdy with minimum of weight.

The marking die is made to take



either individual interchangeable type or solid stamp inserts. Both the die and inserts are constructed from special safety steel to assure maximum service and safety. Marking die rotates continually, thereby eliminating the need for a clutch and speeding up production. A red and green colored plate on outside of rotating shaft indicates when die is in position to allow insertion of the shell. The die is geared to stamp a maximum of 18 shell per min.

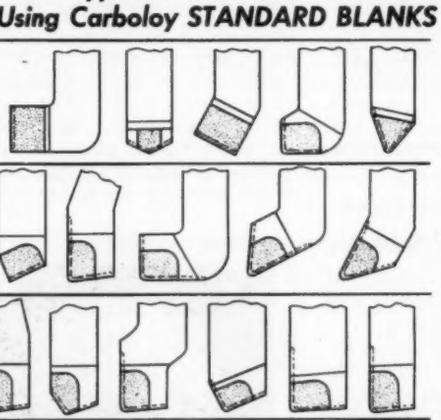
From Blueprint To "Tool-up" In Less Than 1 Hour!

Braze Your Own Carboloy Tools . . . Get Them On Emergency Jobs *FAST!*

Emergency periods call for quick action. When a job must get under way fast—when you need Carboloy tools "yesterday"—*why not braze your own Carboloy tools?* . . . It's a simple short cut that eliminates ordering time and avoids routine "hold ups" awaiting deliveries.

Many plants now keep a stock of Carboloy Standard Blanks in their tool crib . . . ready, on a moment's notice, to make up a tool and get it on the job *fast!* . . . less than an hour for most single-point, straight-shank tools!

A Few Typical Tools You Can Make ...Using Carboloy STANDARD BLANKS



CARBOLOY STANDARD BLANKS ARE AVAILABLE IN 2 STYLES, 65 SIZES AND 3 GRADES

STYLE 100

STYLE 200

Just three simple steps are necessary to do this in your tool room.

1. Preparing Recess in Shanks

To accommodate the Carboloy blank in your tool shank it is necessary to provide a recess in which the Carboloy Blank can be inserted. This is a simple operation that can be done on your regular tool room milling or grinding equipment.

2. Brazing Carboloy Blank to Shank

Brazing the Carboloy Blank to your shank requires less than 5 minutes on most straight-shank, single-point tools. To do this you simply need a torch, and a few inexpensive accessories: Silver solder, flux, carbon tetrachloride, etc.

3. Grinding the Brazed Tool

Simple—fast—as easy as regrinding dull carbide tools, using the now-established, rapid grinding technique, and your regular carbide grinding equipment.

With these three simple steps you're prepared to meet emergency requirements immediately. Why wait—when you can get tools on the job *FAST*—by this simple procedure? Write for instruction booklet GT-116.

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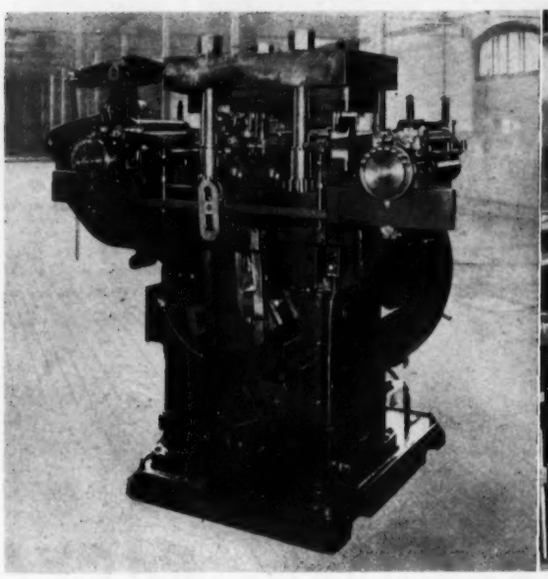
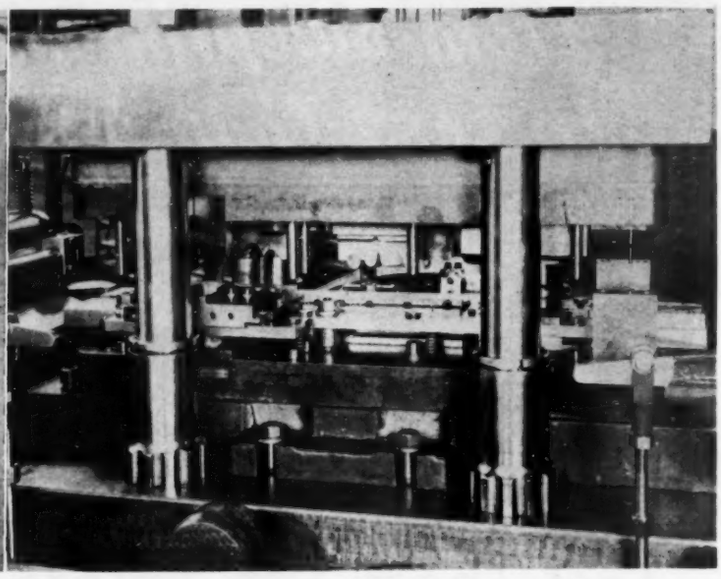
STANDARD STOCK BLANKS
2 STYLES • 65 SIZES • 3 GRADES

Henry & Wright Dieing Machine Speeds Production of Belt Links for Machine Guns



60-ton Henry & Wright dieing machine makes 100 links per min. for .50-cal machine gun belts



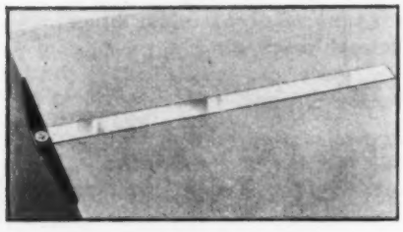
Die arrangement is similar to previous set-ups for belt links but scrap is required on one side only; feed pitch is shorter

A new type of dieing machine especially adapted to quantity production of metallic belt links for use in machine guns has been developed by the Henry & Wright Mfg. Co., Hartford, Conn. The machine illustrated is the 60-ton dieing machine normally used for .50-cal. machine gun belt links. Special 50-ton machines are available for .30-cal. belt link production.

The machine is equipped with automatic double roll feed which feeds the material during only 120 deg. of the crankshaft revolution. This permits reducing the stroke of the 60-ton machine from 5 in. to 3½ in. and reducing the stroke of the 50-ton machine from 4½ to 3½ in. The shorter stroke permits higher speeds and increased die life resulting from lower impact.

An automatic electric stop causes the machine to stop approximately 45 deg. before bottom of stroke in the event of a feed error greater than the pilot can correctly register. Misfeeds occasionally occur due to stock irregularities, but this automatic stop feature eliminates die breakage from this cause. The new dieing machine will produce 130 to 140 links per min. for the .30-cal. machine gun, and 100 to 110 links per min. for the .50-cal. machine gun.

Guiding surfaces are of exceptional area with particularly long surface on the lower crosshead. Machines are available with either direct connected motor drive for a fixed operating speed or with variable speed drive having a speed range of 3 to 1. The machine will handle the latest designs of reduced-scrap types of dies.

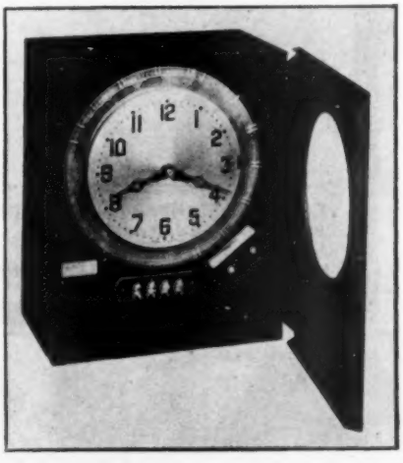


Escolite Plastic T-Square Has Full Transparent Blade

Recently developed and announced by the Engineering Sales Co., Sheboygan, Wis., the new Escolite T-square is particularly adaptable where it is desirable to view the entire drawing without moving the T-square. Head of the Escolite T-square is made of black laminated bakelite composition; blade is of 0.09-in. thick transparent plastic. Materials will not warp, bow, chip, crack or split. There is no finish to wear off, chip or peel. The transparent plastic will not discolor or turn brittle, and will retain its transparency and accuracy indefinitely. Eight cone-shaped pins are accurately and securely set into the head; these pins engage corresponding openings in the blade, eliminating wobble and automatically taking up play. No paper rabbet is necessary because the head is held 1/16 in. away from the blade. The construction provides for swivel head.

Montgomery Memo Program Clock Controls 24 Hr. Signal Schedule

To meet the demand for an economical unit for automatically controlling signals or other devices according to a pre-arranged schedule, Montgomery Time Systems, Owensville, Ind., have developed the Memo Program Clock. It is claimed to be thoroughly accurate and dependable. A slotted brass disk is directly geared to the special self-starting synchronous electric time movement. The slots of this disk are clearly marked to correspond with the time as shown by the conventional clock dial. This disk contains 288 slots. On the Model E-2 slots permit operations at 5-min. intervals throughout 24 hours. On the Model E-3 Memo clock the disk is arranged to provide 2½-min. intervals for operation throughout 12 hours. Any desired schedule is arranged by inserting small spring brass clips into the desired slot of the program disk. The schedule can be changed at any time without the use of any kind of tools. These small metal clips operate a precision switch which partially completes the electrical



You know what you want from your cutting tools. Here's what users are getting from molybdenum high speed steels, in comparison with the tungsten types.

Equivalent cutting properties Greater toughness Lower cost

These are facts — with nine years' experience in thousands of shops to back them up. Check cost and performance records with any user you like. See your supplier for the proper analysis and heat treatment for your requirements.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.
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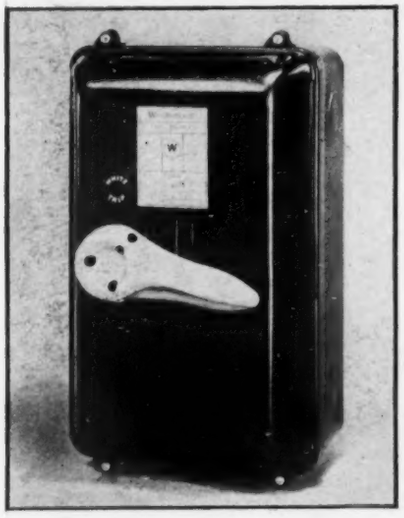
circuit at the exact time. Another switch operated by a cam in the movement completes the circuit for a definite length of time. Duration of operation can be arranged for any time between 3 sec. and approximately 1 min. as specified on order. Standard setting is 5 sec. for general signaling.

Multi-Breaker for General Use Available from Westinghouse

A new low-cost multi-breaker is announced by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., for use on any normal duty application that would otherwise require fuses or fuse switches. In operating, a bimetal ther-



mal element is actuated by overload or short circuit and causes the breaker to trip. However, while the breaker trips immediately on short circuits or dangerous overloads, an inverse-time characteristic allows it to remain closed during temporary harmless overloads. An indicating target on the inclosure cover shows when the multi-breaker has tripped.

Available in two types: M-1 and M-2. These 15 to 100 amp., two or three pole breakers are for use on a.c. circuits up to 230 volts. Sheet metal inclosure is dust resisting (NEMA Type 1-A) with 10 concentric knockouts for conduit or cable connections.

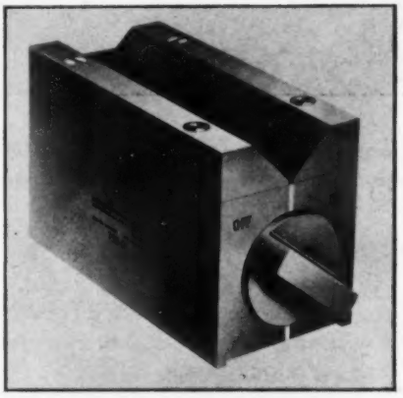
"Wheel About" for Tool Chest Announced by Plomb Tool

A mobile tool cabinet built on the principle of the "add-a-shelf" book case, and on top of which may be mounted the Master tool chest, has been announced by the Plomb Tool Co., Washington and Santa Fe Aves., Los Angeles, Calif. The assembly permits moving the complete tool set from job to job, or removal of either the upper or lower tool chest complete for use on outside jobs. The cabinet, mounted on four easy-rolling casters, is large enough to carry a tote tray, has lock

and key, and a door that lifts up and slides out of the way. The Master tool chest has four drawers operating on roller slides. Top lifts up, and has clips for holding speeders. Lock and key of the tool chest is identical with that of the cabinet. Both units are round cornered, and are painted Chinese red. Over-all measurements of the unit are 44 in. high by 27 in. wide, by 17 in. deep.

B. & S. Adds V-Block Of Permanent Magnet Type

A reliable and handy tool for holding iron or steel work of round or rectangular cross section, as well as irregularly shaped pieces which can be placed between and contact the V-faces, has been added to the line of permanent magnetic holding tools of the Brown & Sharpe Mfg. Co., Providence, R. I. Magnetic V-block No.

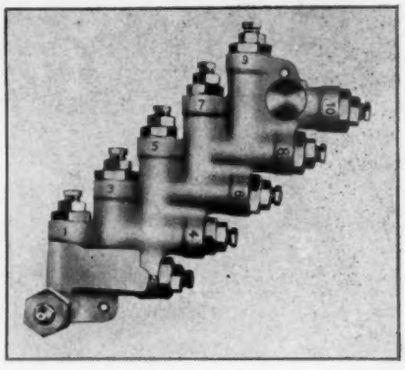


750D is of small and convenient size with an overall width of 2½ in., an overall height of 3¼ in., and overall length of 6¼ in., and with a capacity of 1¾ in.

When the control of the block is turned "on," work is firmly held in the V, and if the block rests on a magnetically conductive surface it in turn is firmly held to this surface. Work and V-block are both released when the control is turned "off." Holding power can be regulated by giving the control a part turn so that work can be removed from or positioned in the V without releasing the block from the conductive surface.

Alemite Progressive Lubricators Handle from 3 to 20 Bearings

From one central point the new Alemite progressive lubricating systems, just announced by the Alemite Div., Stewart-Warner Corp., 182 Diversey Parkway, Chicago, Ill., will deliver a

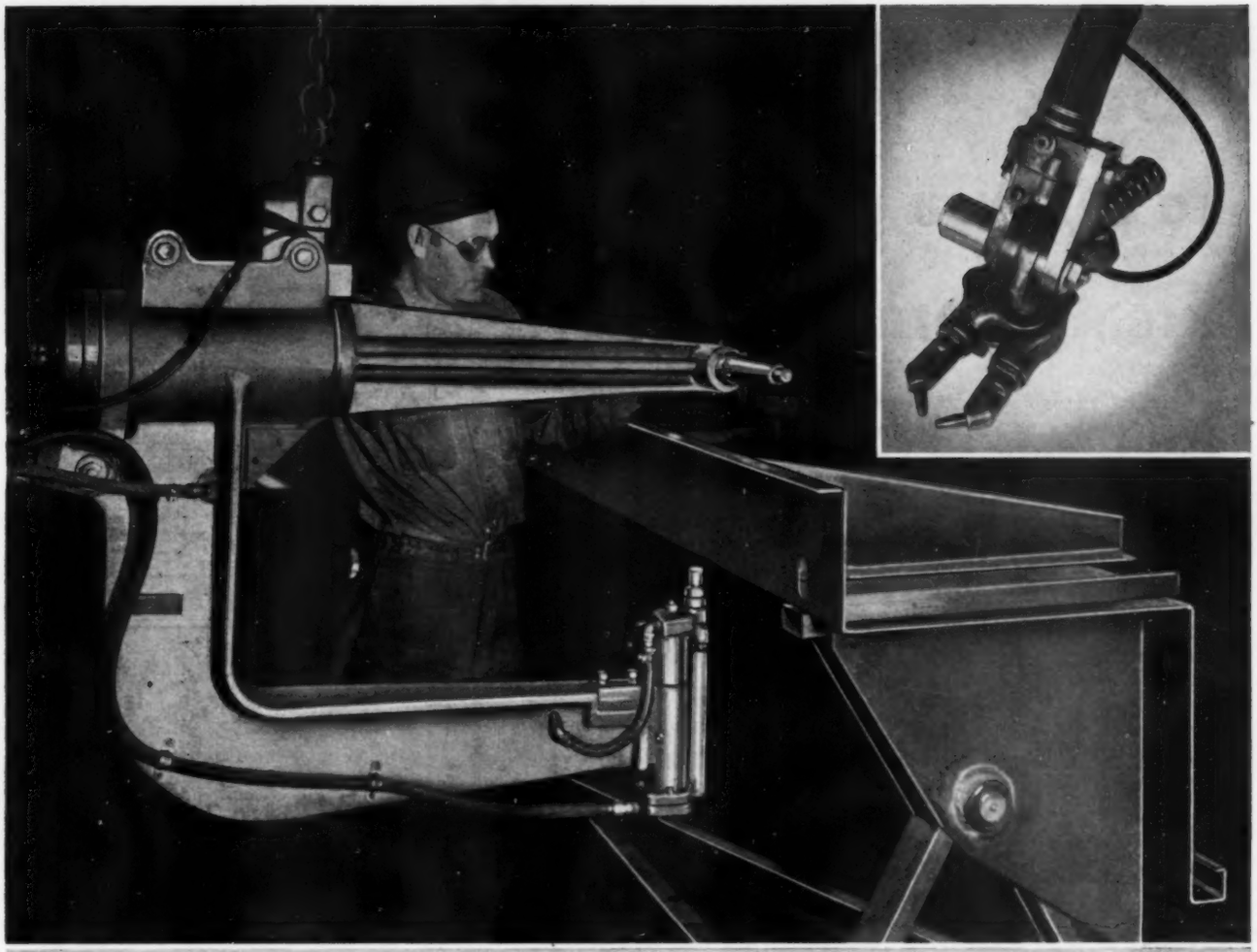


pre-determined quantity of lubricant to from 3 to 20 bearings. When the job is completed, a readily visible indicator signals the operator. The lubricators can be employed in relays on equipment that involves a large number of bearings. Any type of manually or power-operated high pressure grease gun can be used with the systems.

One system or a relay of the Alemite progressive lubricating system can be installed on the most intricate piece of machinery with ease. Inaccessible or dangerously located bearings can be conveniently located at will; the system provides ample lubrication. All bearings are lubricated simultaneously from one central point. The machines can be lubricated while being operated.

Splash Proof Housing Developed for Micro Switch

Micro Switch Corp., Freeport, Ill. is now furnishing a splash-proof housing for the standard Bakelite Micro Switch, for use where closely held operating points and movement differ-



GUNS *behind the lines*

Guns to build planes—guns to build plants—guns for tanks and trucks—guns for the myriad of items needed for national defense from ammunition boxes to soup kitchens.

To see that resistance welding guns—the "guns behind the lines" are available for whatever purpose they may be needed: to speed production, to simplify manufacture, to cut costs—and as fast as needed—is Progressive Welder's business.

ILLUSTRATED ABOVE

Swivel construction of the upper electrode in this Standard Progressive "C" type gun enables clearing of obstructions in welding formed steel sections. (Available with long or short throats, without swivel feature, etc.) Insert shows a standard Progressive gun for lighter work—featuring self-locking full swiveling action, single pin cable clamp and P-H flexible kickless welding cable. There are several hundred 'standard' and semi-standard guns in the Progressive line—pinch guns, push guns, expansion guns, etc.

Today, with a new plant providing ample manufacturing facilities Progressive is able to fill all indicated needs for portable welding guns. Furthermore, there is a standard Progressive gun for virtually every conceivable job, large or small—from inch sections to light gauge aluminum and stainless—cutting design costs and delivery time. Your blueprint will bring you a quotation virtually by return mail. Write or wire direct to our main office or the following:

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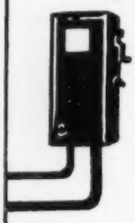
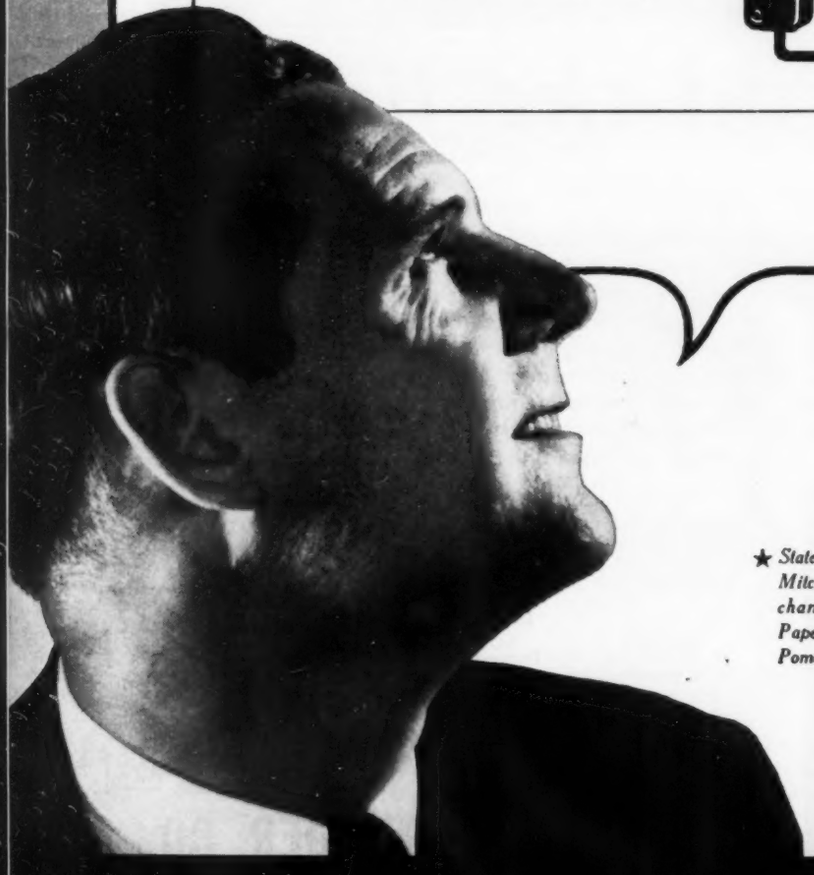
Bill-- Here's a tip to help you get that new plant operating sooner

"We've found that we can save as much as 50% of the time required for installing control by using G-E combination starters for the motors in our plant." ★

HERE'S WHY G-E COMBINATION STARTERS CAN BE INSTALLED MORE QUICKLY



THIS	Instead of	THIS
1	Devices to mount	2
2	Lengths conduit to cut	3
2	Conduit ends to thread	4
6	Wires to pull	9
6	Power connections to make	12



★ *Statement by R. L. Mitchell, master mechanic, Fernstrom Paper Mills, Inc., Pomona, Cal.*

GENERAL ELECTRIC

entials are needed and where any splashing may occur. Feature of the switch is the variety of mounting positions. There are two tapped holes for No. 10-32 screws on each of the four sides. This makes it possible to mount the switch directly to a machine frame from practically any position whether the switch has the roller arm, cross-roller arm, or push-rod plunger type of actuation. Lug or foot mounting can also be furnished.

Both types of roller arm are of aluminum, adjustable through 360 deg. with the roller of a non-sparkling material of high concentricity. Roller rides on an oilless bronze bearing. Overtravel of switch is 90 deg. Plunger type of actuator has a bullet-nose push rod of case-hardened steel which moves in a long cadmium-plated hexagonal bushing. Removable cover provides access to rugged terminals. Switch can be easily removed for inspection.

NEW MATERIALS

Laminum Shim Stock Now Available in 7-In. Widths

To permit the cutting of larger one-piece shims from Laminum shim stock, the Laminated Shim Co., Inc., Union St., Glenbrook, Conn. has now placed in production sheets of Laminum in sizes up to 7 x 36 in. Not only does this new width permit the company to manufacture larger jointless shims, but this new size shim stock affords the same convenience to purchasers of Laminum shim stock who cut their own shims. The new sheets are available in over-all thickness from 0.006 to 0.125 in. All of these thickness can be obtained in all-laminated sheets with choice of 0.002 or 0.003-in. thick laminations. Various thicknesses can also be manufactured partly laminated and partly solid.

Republic Engineering Applies Sensitized Emulsion to Metals

Materials other than aluminum, such as steel plate, brass, copper, various steel alloys, as well as plywood and plastics, can now be coated with sensitized emulsion suitable for making photographic copies. The new process, just announced by Republic Engineering Products, Inc., 480 Lexington Ave., New York, N. Y., permits interested manufacturers to continue with their use of sensitized metal sheets in spite of restricted aluminum supplies.

Some of these sensitized materials can be secured in any commercial thickness, such as ⅛ or ¼ in. cold rolled steel—the type used for making templets. In such cases the drawing is photographed directly on the sensitized surface and then developed. The sensitized metal is also ideally suited for name plates, instrument dials, escutcheon plates and permanent instruction sheets.

TRADE PUBLICATIONS

BLOWERS & GAS PUMPS Root-Connersville Blower Corp., Connersville, Ind. is circulating a six-page folder, No. VA-102, covering applications of blowers and gas pumps for use with a wide variety of oil and gas fired units.

CARBURIZING The Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia, Pa., is circulating a 28-page catalog, No. T-623, "Homocarb Method for Carburizing." The booklet takes the reader on a pictorial tour of representative heat-treats, shows a score of furnaces in action, various types of work being carburized, and indicates how the results are obtained.

CONVEYORS Lamson Corp., Syracuse, N. Y. is circulating a 4-page folder, Vol. 2, No. 5, which illustrates and describes the operation and application of conveyors.

COUPLED REDUCTION GEARS A new eight-page booklet, No. B-2278, describing coupled reduction gears for driving compressors, line shafts, generators, is being circulated by Westinghouse Electric & Mfg. Co. Included is a discussion regarding precision hobbing to give quiet, smooth operation with a note on the cutting of gear and pinion helices.

CUTTER GRINDER General Machinery Corp., 140 Federal St., Boston, Mass. is circulating an eight-page catalog which illustrates and describes the precision cutter grinder.

ENGINEERING STANDARDS The American Standards Association has completed the revision of American Standard Abbreviations for scientific and engineering terms. The standard, "Abbreviations for Scientific and Engineering Terms," (Z10.1-1941), is now available in pamphlet form from the American Standards Association, 29 W. 39th St., New York, N. Y., at 35 cents per copy.

FOREMEN TRAINING The Industrial Relations Section, Department of Economics and Social Institutions, Princeton University, Princeton, N. J. is circulating an Industrial Relations Digest, No. 8, "The Selection and Training of Foremen." The eight-page booklet, which sells for 20 cents, also contains a bibliography.

GRINDING MACHINES Catalog No. J-241, circulated by Landis Tool Co., Waynesboro, Pa., illustrates, describes, and provides specifications of hydraulic universal grinders.

HIGH CHROME DIE STEEL Jessop Steel Co., Washington, Pa. is circulating an eight-page Bulletin, No. 341, which describes the forging, annealing,

Thanks Joe . . . we're already using combination starters . . . they're safer

"We have found that our men can maintain G-E combination starters without danger, thanks to the safety-interlocked enclosure which separate units do not have."★

1 SAFER because the circuit switch has ample capacity to interrupt stalled-rotor current of the controlled motor.

2 SAFER because the cover can't be opened as long as the switch handle is in the ON position and power is applied to exposed parts.

3 SAFER because, whenever the cover is open, power can't be applied to the starter by accidental closing of the switch handle.

★ *Statement by Raymond Dingler, chief electrician of a large western cement plant*

Send for "How to Get More for Your Control Dollar" (GES-2456) General Electric Company, Schenectady, N. Y.

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DON'T OVERLOOK THIS VERY IMPORTANT FACTOR!

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Liquid Grinding Compound

100% grinding efficiency is best accomplished by careful consideration of the grinding fluid factor. The vital part which a properly applied, specialized grinding lubricant plays is too often overlooked. It can mean unnecessary sacrifice in quality of finish production speed, and cost of wheels.

These handicaps can frequently be eliminated by going over your grinding problems with a STUART OIL Engineer. His highly specialized experience in the application of modern grinding fluids will help you secure top efficiency.

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hardening, tempering, coefficient of expansion, and the resistance to corrosion and oxidation of high carbon-high chrome die steel.

HYDRAULIC HOISTS Gar Wood Industries, Inc., Detroit, Mich., is circulating a four-page folder, No. 29, which illustrates, describes and provides general specifications of the arm-type hydraulic hoist.

HYDRAULIC RAM The Engineering Experiment Station, University of Illinois, Urbana, has reported on "An Analytical and Experimental Study of the Hydraulic Ram." The 52-page booklet, No. 22, sells for 75 cents.

LATHE STANDARDS The American Standards Association has published a new standard setting up requirements for accuracy of engine lathes. The standard provides a series of 25 tests to be applied in checking engine lathes for accuracy. Copies of the new standard, "Accuracy of Engine Lathes," (B5.16–1941), are now available from the American Standards Association, 29 W. 39th St., New York, N. Y. at 25 cents per copy.

LIFT TRUCK Lyon Iron Works, Greene, N. Y., is circulating a four-page Bulletin, No. 123, which illustrates the operation of hydraulic lift trucks. Specifications of the more popular models have been included.

MATERIALS HANDLING Link-Belt Co., 307 North Michigan Ave., Chicago, Ill., has just published a 28-page catalog, No. 1975, which illustrates and describes a power operated conveyor system for the continuous conveying of flowable granular, crushed, or pulverized materials in capacities of up to 140 tons per hour.

MATERIAL SELECTION Continental-Diamond Fibre Co., Newark, Del. is circulating an eight-page folder which provides information regarding the selection of non-metallic materials for particular uses.

METAL BELLOWS The Fulton Sylphon Co., Knoxville, Tenn. offers a concise 28-page catalog, No. 130, on seamless metal bellows and bellows assemblies, largely used by instrument, appliance and machinery manufacturers. The illustrated catalog indicates fundamental applications of the seamless metal bellows, describes both roll formed and hydraulically formed bellows in single and multi-ply types.

MOTORS Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., is circulating an eight-page booklet, No. 4004, which illustrates and describes direct-current motors for service in mills and general industry. Several recent improvements, such as sealed-sleeve bearings, rigid frame and foot design, directed ventilation, and adjustable brush holders are illustrated and described.

OIL CIRCUIT BREAKERS Westinghouse Electric & Mfg. Co. is circulating an 8-page bulletin, No. 33-216, which illustrates and describes oil circuit breakers for indoor service. The breakers are rated 25,000 kva interrupting capacity, manually and electrically operated. Advantages of operating levers inside the breaker chamber are discussed. Operation details cover mounting arrangements, the solenoid mechanism, and tripping coils.

PACKING A completely illustrated catalog, No. PK-12A, describes the operation and application of packings and gaskets. The booklet contains service recommendations and detailed information on gasket styles. The booklet is being circulated by Johns-Manville, 22 E. 40th St., New York, N. Y.

PICKLING TANK CONTROL The Foxboro Co., Foxboro, Mass. is circulating a four-page folder which illustrates and describes the maintenance of a constant pickling bath temperature by automatic control.

PORTABLE SUBSTATIONS An 8-page booklet, No. B-2281, illustrates and describes portable substations to meet the current demand for emergency power, and is being circulated by Westinghouse Electric & Mfg. Co. Units with voltage ratings up to 69 kv. and capacities up to 4,500 kva are discussed.

PROTECTIVE FENCES Anchor Post Fence Co., Baltimore, Md. is circulating a 40-page catalog, No. 110, which contains 60 illustrations showing fourteen different models in various settings in industrial plants.

ROTARY PUMPS Worthington Pump & Machinery Corp., Harrison, N. J., is circulating a 12-page Bulletin, No. W-483-B1, which illustrates, describes, and provides sizes and ratings of rotary pumps with double-helical gears.

SPECIAL STEELS Allegheny Ludlum Steel Corp., Pittsburgh, is circulating two data manuals, one concerned with tool steel, the other with stainless steel. The material is sufficiently elemental to give students a clear picture of the analyses, treatment and basic uses of the alloys discussed and at the same time the booklets are also inclusive enough to be of value to anyone who works with or uses special steels.

THREADING MACHINERY Landis Machine Co., Inc., Waynesboro, Pa., is circulating a new bulletin which covers an entire line of threading machines, collapsible taps and die heads.

TUBE DATA A one-page chart is being circulated by the Steel & Tubes Div., Republic Steel Corp., Cleveland, Ohio, which provides a useful compilation of electric resistant welded tube data including sizes, tolerances, weight per foot, chemical analyses and physical properties of round tubing and also squares and rectangles.

TUBE MOVEMENT The Imperial Brass Mfg. Co., 1200 W. Harrison St., Chicago, is circulating a 16-page bulletin, No. 3101, which discusses the problem of eliminating fitting and tubing failure resulting from vibration or tube movement in mechanical equipment. Specific recommendations are provided.

TURBINE - GENERATORS Turbine-generators, 200 kw. and above, for marine service are illulstrated and described in a 4-page folder, No. F-8571, circulated by department 7-N-20, Westinghouse Electric & Mfg. Co. The general discussion includes such features as space conservation, accessibility of parts, and directed air flow.

USED MACHINE TOOLS Moore Machinery Co., 3876 Santa Fe Ave., Los Angeles, Calif. is circulating an 8-page catalog which lists the number and type of used lathes, milling machines, drills, drill presses, etc. which are on hand.

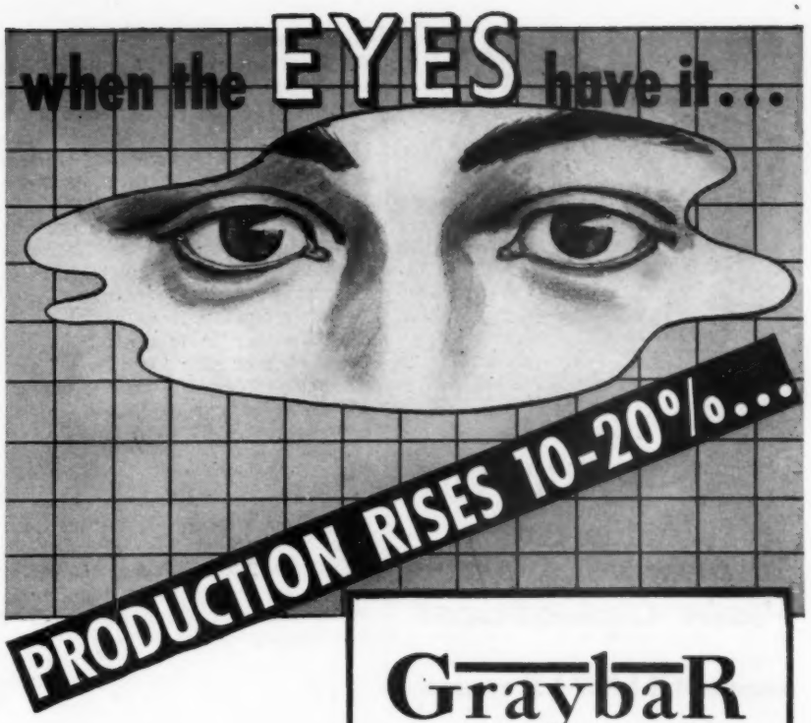
VALVES AND HOISTS Hanna Engineering Works, 1765 Elston Ave., Chicago, is circulating a 28-page catalog, No. 230, which illustrates and describes the construction and operation of air cylinders, control valves and hoists.

NEW BOOKS

1941 WAGE AND HOUR MANUAL—*1,100 pages. Published by the Bureau of National Affairs, Inc., 2201 M St., Washington, D. C. $5.00.*

Out of the bewildering variety of interpretations, opinions, wage orders, rules and regulations which together comprise the Wage and Hour Law has come the *1941 Wage and Hour Manual,* a book which a large number of law-harassed business executives and manufacturers are certain to find a guiding light in a wilderness of special legislation. The book embraces, so far as can be discovered, all documents carrying material on government regulation of wages and hours—the laws, administrative regulations and interpretations, and decisions of the court. The documents are fully indexed and generously interspersed with non-technical explanatory articles. Supplementing the basic material are some 200 authoritative answers to questions on the law of application to specific cases, graphs illustrating the scope of various exemptions, sample payroll forms and other devices designed to translate the law into terms understandable by the lay employer.

The volume is in three parts, the first containing seventeen chapters which treat separately the overtime, minimum wage and other provisions of the fair labor standards. In part II, similar attention is given to the Walsh-Healey Public Contracts act and miscellaneous federal laws regulating wages and hours. State legislation is



Many plants doing close-tolerance work have found that the "eyes" hold the answer to greater production from present machines. Sight-saving, shadowless lighting has upped production 10-20%.

Screwing in "brighter bulbs" is not the answer; high-level lighting must be carefully planned to avoid glare, excessive contrast. Only experienced specialists in industrial lighting can analyze individual needs.

GRAYBAR offers a full line of modern factory and office lighting units, plus skilled help from lighting specialists. Write for bulletin No. 40 on new fluorescent fixtures which save money while speeding production. Department AM, Graybar Electric Company, Graybar Bldg., New York.

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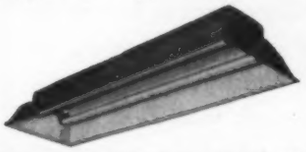
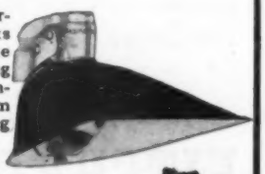


There are many places you can use the new RLM fluorescent lighting units to provide more effective, lower-cost light in plant, office and for sales displays — daylight in a dozen ways.

SILVRAY (silvered-bowl lamp luminaires) — high-efficiency, sight-saving, indirect lighting combined with beauty in design, plus long life, low maintenance cost, easy lamp replacement.

Benjamin Glassteel Diffusers assure soft, even light over a wide range of intensities. Direct and reflected glare is eliminated. Complete with hood, reflector and globe.

Benjamin Duo-Service Floodlights combine a wide coverage diffusing reflector with an intensive beam floodlighting projector.



Crouse-Hinds floodlight projectors, floodlights and searchlights—for yards, sidings, storage tanks, loading platforms and other outdoor areas.

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New Free Booklet

FITCHBURG

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treated more briefly in part III with a digest of wage, hour, child labor and industrial homework regulation for each state. The editors have devoted 50 pages to an exhaustive topical index and a table of cases which add immeasurably to the value of the volume as a reference source. A compilation of all court decisions under the Wage and Hour Law to March 1941 should be of particular value to manufacturers. Some 120 opinions, with a carefully written head note, are presented either in text or digest form. Each chapter also includes an analysis of court decisions on the particular topic treated.

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JIG TOOLS AND FIXTURES. *Second edition—By Philip Gates, late lecturer in machine construction and drawing, Aylesbury Technical School, England. 209 pages. Published by the Chemical Publishing Company, 234 King St., Brooklyn, N. Y. $4.00.*

In this volume the author attempts to cover a good deal of ground. He deals with jig fixtures, small tools and accessories and in addition includes chapters on mechanical drawing, gages, cams and materials. As a former technical school lecturer he has the beginner primarily in mind which accounts for his rather broad coverage of the subject.

The volume is well illustrated with line cuts, showing tools of various kinds, and with halftones showing machine set-ups. In addition the text is interspersed with numerous tables listing chiefly tool and gage proportions. The chapter on materials has been added since the last edition.

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THE AMERICAN MINERS' ASSOCIATION—*By Edward A. Wieck, Research Associate, Department of Industrial Studies, Russel Sage Foundation. 330 pages. Published by Russell Sage Foundation, 130 E. 22nd St., New York, N. Y. Price, $2.00.*

This study traces the origins of miners' unions in the United States, particularly the rise of the American Miners' Association in the early sixties. From the earliest start of the trade union movement, coal miners have occupied a position of strategic importance. The United Mine Workers of America has been one of the most powerful unions for many years, and a study of the historical background of this union is important now when the national labor policy is going through an important stage in its development.

The origin of the American Miners' Association and its history are inseparable from the development of the nation's social economy. This association grew out of a strike in the coal industry in Illinois early in 1861. This strike, which began in the week of January 21, 1861, was at first a spontaneous protest against reductions in the mining rate per bushel paid by the coal operators which followed the financial panic of 1860 which ushered in a business depression. From that early beginning, the author traces the history and far-reaching effects of this early union. Included in the book are numerous source references and an appendix which contains the complete texts of important documents used in the study. These should be invaluable to the student of the growth of unionism and its relation to our industrial economy.

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A GOOD MECHANIC SELDOM GETS HURT—*By Herman R. Graman. 94 pages. Published by American Technical Society, Drexel Ave. at 58th St., Chicago, Ill. 50 cents.*

Written especially for young men who wish to start the "safe" way when learning their trade, and who are willing to benefit from the experience of others, this book is prepared in an easy-to-read style and the various safety precautions for each machine are grouped together. Thus, a student or mechanic using certain machines can turn to the section in the book covering those machines and he will find there suggestions as to what can and cannot be done when working safely. Most of the rules in this book are not new, but the author has endeavored to organize safety rules so as to give the beginning craftsman an idea of what to look out for when he is working in a machine shop. Some of these rules have come to the author from personal observation and experience, others were received from foremen and instructors, while others are found in standard texts and reference works.

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FLIGHT—CONSTRUCTION AND MAINTENANCE—*By Bailey Wright, W. E. Dyer and Rex Martin. 264 pages. Published by American Technical Society, Drexel Avenue at 58th Street, Chicago. $2.50.*

This is in every sense a "how-to-do-it" book. It begins with blueprint reading. A section follows on woods used in aviation, with detailed requirements for airplane construction. Seventy-four pages are given over to elementary metallurgy and to oxyacetylene welding. There are chapters on production line manufacture of the airplane and on details of wing, fuselage, tail and landing gear construction; on rigging airplanes, including biplanes; on the repair of the airplane; and on the airplane propeller. Quiz questions and answers are helpful to the reader in seeing whether he has mastered the book's general contents. The book has a good index and contains 354 drawings and photographs. It serves well the layman and the beginner and also appears suitable for use in schools.

Suggestion System

By H. R. HAGEMAN

One of the major factors which prevent 100 per cent cooperation in boosting a suggestion plan is the inability of some department foremen to disabuse their minds of the notion that any suggestion which concerns their respective departments reflects upon their own efficiency. No matter how much they try to conceal it the truth will out, and any employee who knows how to get along with his superiors will pass up any problematic suggestion benefits in order to maintain smooth sailing in his daily work.

Other factors which make for the success or failure of the system depend upon the committee or individuals who pass upon the merits of the suggestions.

It would seem natural for the department head to be consulted about the adaptability of any suggestion which concerns his department, but the consultants should be capable of over-ruling the objections of such foremen as mentioned above.

Believe it or not, there are times when a suggester is more interested in having his idea put into use than in any monetary reward. It is, therefore, a mistake, as has been known to happen, for the committee to slight its job by accepting a suggestion, making the minimum award and immediately dropping the entire matter.

Recognition for the Apprentice

One of the proud moments in the life of a young man is his graduation from High School or College. The commencement exercises, the official ceremonies, and the presentation of his diploma mean official recognition of his efforts and give him a new dignity which is of material value in facing his future responsibilities. Until recently, graduates from apprenticeship courses did not receive the same recognition. Too often the transition from trainee to skilled worker went practically unnoticed.

However, this is being corrected. A good example of intelligent handling is that of the Thompson Products, Inc. This company for the second year, has celebrated the graduation of an apprentice class with appropriate ceremony. Regular class-day exercises are held with addresses by the company's director of personnel, the president and an outside speaker in this case, Dr. William E. Wickenden, president, Case School of Applied Science. One of the members of the graduating class, acting as valedictorian, responded with an address, "Apprenticeship in a Democracy."

F. C. Crawford, president, Thompson Products, Inc., then presented a handsome diploma to each member of the graduating class. The class day program was printed in a booklet which included photographs of each graduate, the faculty conducting the course and a group of all the apprentices.

Thor REDUCES SIZE, WEIGHT OF TOOLS WITH ANTI-FRICTION NEEDLE BEARINGS

THIS COMPACT THOR hand-model U1N Nibbler weighs only 3¾ lbs., yet packs in plenty of power. How was it made to fit the hand? "The Torrington Needle Bearing's very small O.D. makes possible our compact, streamlined gear case," says Mr. G. Larson, Independent Pneumatic Tool's Chief Designer, "and the Needle Bearing gives us good anti-friction service without trouble, in the Nibbler and many other Thor tools."

THE NEEDLE BEARING operates at high speeds in this fairly inaccessible location, but no extra lubrication system is needed because large supplies of grease are held within its race. The Needle Bearing offers further economy in its simple installation and its surprisingly low initial cost.

If you have a bearing problem where high load capacity, small size, light weight, ease of installation and lubrication, and low costs are vital factors, investigate the Torrington Needle Bearing. Our Engineering Department will gladly help you adapt its advantages to your design. For details write for Catalog No. 105. For Needle Bearings to be used in heavier service, write our associate, Bantam Bearings Corporation, South Bend, Ind., for Booklet 103X.

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1866 75 YEARS OF MANUFACTURING PRECISION PRODUCTS 1941

Forced Down in the Bush with a Load of Gold

. . . and a blizzard coming on

Thousands of miles away from civilization. Only days away from the first big snows. Several lives in danger . . . not to mention the plane, the gold in its hold, and a hard-won freight contract with the mines up north. All caused by nothing more than a broken con-rod. But the motor was made in England . . . *and there were no parts to be had.*

The airline's desperate, continent-wide SOS soon singled out Taft-Peirce. Eight days later a perfectly ground and balanced rod flew north from Woonsocket. And two days after that the death-sentenced plane flew south, crew and cargo safe.

For the Taft-Peirce Contract Manufacturing Division has known British motors, as well as American, ever since planes were first built. In fact, this unique organization is competently experienced in every field of industry . . . in design, development, tooling, and production on any scale from a single part to complete mechanisms in quantity. If you would like to know more about this complete Contract Service, write to The Taft-Peirce Manufacturing Co., Woonsocket, R. I.

Take it to Taft-Peirce

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